2004

An analysis of marginal effects of land characteristics and purchase factors on rural land values in north Louisiana

Rebecca Summers McLaren
Louisiana State University and Agricultural and Mechanical College, rmclar1@lsu.edu

AN ANALYSIS OF MARGINAL EFFECTS OF LAND CHARACTERISTICS AND PURCHASE FACTORS ON RURAL LAND VALUES IN NORTH LOUISIANA

A Thesis

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
In partial fulfillment of the
Requirements for the degree of
Master of Science

in

The Department of Agricultural Economics and Agribusiness

by
Rebecca Summers McLaren
B.S., Louisiana State University, 1998
December 2004

ACKNOWLEDGEMENTS

I would be remiss in the accomplishment of this thesis not to acknowledge those who gave their time and effort in helping to make it possible. First among those I wish to thank is Dr. Steve Henning. His guidance, patience, and time were invaluable in the development and completion of this research. He offered information and resources from his wealth of experience that provided depth to this research and furthered my understanding of this material. I have thoroughly enjoyed working with him and look forward to any opportunity I may have to work with him in the future.

I would also like to thank my other committee members including, Dr. Lonnie Vandeveer and Dr. Mike Salassi. I am grateful for their time and effort spent in reviewing this research. I also appreciate all their suggestions and guidance.

Additionally, I would like to thank all of the professors within the department, many of whom I have had the privilege of learning under. I value your time and effort that have collectively resulted in the completion of this project. Thanks also to Dr. Gail Cramer, Department Head of Agricultural Economics and Agribusiness for his willingness to be so supportive of graduate endeavors.

I would also like to specifically thank Ms. Jane Niu, Instructor and GIS Manager for her patience and time in helping with the GIS resources that were used in this project.

Finally, through what has been a tumultuous year, there have been many friends and family that have been so supportive. To these special people, I give my most sincere and heartfelt thanks. I wish to particularly thank my parents, David and Dianne Summers, and Jacob and Monique Fontenot, Lance and Paula Beecher, Sean and Julie Barrere, Matt and Lauren Summers, Jack and Betsy McLaren, Pam Fenn, and especially my fellow graduate students James Henderson, Michael Bruchhaus, Brian Boever, Tina Willson, Anil Sulgham, Pramod Sambidi, Christiane Aust, and Young Jae Lee for all their help and for making this experience so enjoyable.

TABLE OF CONTENTS

ACKNOWLEDGEMENTS………………………………………………………… ii

LIST OF TABLES………………………………………………………… v

LIST OF FIGURES………………………………………………………… vi

ABSTRACT………………………………………………………… vii

CHAPTER

1 INTRODUCTION…………………………………………… 1
- Overview of Northern Louisiana Rural Land Market….. 1
- Problem Statement…………………………………… 19
- Justification…………………………………………… 20
- Research Objectives…………………………………… 21
- Research Procedures…………………………………… 22
- Organization of the Thesis……………………………… 25

2 LITERATURE REVIEW…………………………………… 26

3 METHODS AND PROCEDURES……………………………… 30
- Hedonic Pricing Model………………………………… 30
- Marginal Implicit Prices of Characteristics……………… 32
- The Study Area………………………………………… 32
- The Data……………………………………………… 35
- The Variables…………………………………………… 36

4 EMPIRICAL RESULTS…………………………………… 47
- Descriptive Results…………………………………… 47
- Interpretation of Model Coefficients…………………… 49
- Marginal Implicit Prices of Characteristics……………… 52
- Summary……………………………………………… 58

5 SUMMARY AND CONCLUSIONS……………………………… 60
- Summary……………………………………………… 60
- Conclusions…………………………………………… 63
- Further Research and Limitations………………………… 64

REFERENCES………………………………………………………… 66

APPENDIX: SOIL CLASSIFICATION………………………………… 68

VITA………………………………………………………… 70

LIST OF TABLES

1.1. 2002 Agricultural Production Acreage by Submarket for Leading Crop Production………………………………………………………. 6

1.2. 2002 Timber Harvest and Value by Submarket for Pine and Hardwood……………………………………………………………….. 7

3.1. Continuous Hedonic Pricing Model Variables, North Central, North Delta and Red River Submarkets, Louisiana…………………………….. 39

3.2. Discrete Hedonic Pricing Model Variables, North Central, North Delta and Red River Submarkets, Louisiana…………………………….. 40

3.3. Summary Statistics of Socioeconomic Variables for Louisiana…………. 43

4.1. Descriptive Land Characteristics, North Louisiana Submarkets, Rural Land Survey, January 1, 1993 to June 30, 2002………………………….. 48

4.2. Estimated Hedonic Model, North Louisiana Submarkets, Rural Land Survey, January 1, 1993 to June 30, 2002………………………………… 50

4.3. Estimated Hedonic Model and Marginal Implicit Prices, North Louisiana Submarkets, Rural Land Survey, January 1, 1993 to June 30, 2002……………………………………………………………….. 54

A.1. Soil Classification Identification…………………………………………. 69

LIST OF FIGURES

1.1. Submarkets of Louisiana………………………………………………. 2

1.2. Population in 2000 by Parish in Louisiana……………………………….. 3

1.3. Population Comparison from 1990 to 2000 by Parish in Louisiana……… 4

1.4. Corn Production in Northern Louisiana………………………………….. 8

1.5. Cotton Production in Northern Louisiana………………………………... 9

1.6. Rice Production in Northern Louisiana…………………………………... 10

1.7. Sorghum Production in Northern Louisiana……………………………… 11

1.8. Soybean Production in Northern Louisiana………………………………. 12

1.9. Wheat Production in Northern Louisiana………………………………… 13

1.10. Pulpwood Production in Northern Louisiana…………………………….. 14

1.11. Saw Timber Production in Northern Louisiana………………….............. 15

1.12. Northern Louisiana Land Sales by Submarket including MSAs………… 17

1.13. MSAs and Parish Seats of Louisiana…………………………………….. 18

3.1. Northern Louisiana Soil Classification Map……………………..……. 34

3.2. Northern Louisiana Rural Land Sale Observations………………………. 37

ABSTRACT

Hedonic models estimate the marginal effect of land characteristics and factors that contribute to a purchase decision on rural land values in submarkets of north Louisiana. While size of tract and mix of land use have expected impacts on rural land values, forces that motivate the buyer also affect price. The natural resource endowment of each of the three submarkets in this study differs significantly from one another. Topography has clearly identifiable impacts on crop selection and income in each submarket. Additionally, the relative location of the submarkets to major metropolitan areas is influential on rural land values in one submarket, and in the others the socioeconomic conditions within the submarket are more influential on rural land values. As a result, the factors that contribute most to the value of rural land in each submarket differ. This study successfully demonstrates that these differences are statistically significant in explaining the value of rural land.

CHAPTER 1

INTRODUCTION

Overview of Northern Louisiana Rural Land Market

Northern Louisiana has historically relied heavily on agriculture to sustain local economies. In a relatively small geographical area there is much diversity within the agriculture that is supported. The majority of agricultural crops are comprised of timber, cotton, soybeans, corn, or cattle. Land in any particular submarket has a higher likelihood of being in one area of agricultural production or another. Northern Louisiana is interesting because of the variety of topography that exists among the three submarkets that make up most of the northern part of the state.

Previous research has found that nine distinct rural land submarkets exist in Louisiana as shown in Figure 1.1. Each submarket is characterized as being somewhat geographically homogeneous and has similar soil, topography, and socioeconomic characteristics. The northern portion of the state is divided into three submarket areas: Red River, North Central, and North Delta and includes 23 of the 64 parishes in the state. The population in the North Delta submarket is 273,156, while the Red River submarket has 544,208, and the North Central submarket 186,319. The combined population of the three submarkets is approximately 1,000,000 as of 2000, according to the U.S. Census information. This total comprises about 22 percent of the state population. Most of the parishes within northern Louisiana have less than 50,000 people, as shown in Figure 1.2. Exceptions to this include the parishes of Caddo, Bossier, Ouachita, and Rapides which also contain the most populous cities. From 1990 to 2000, the population within northern Louisiana remained virtually the same, increasing by only 2 percent over this time period.

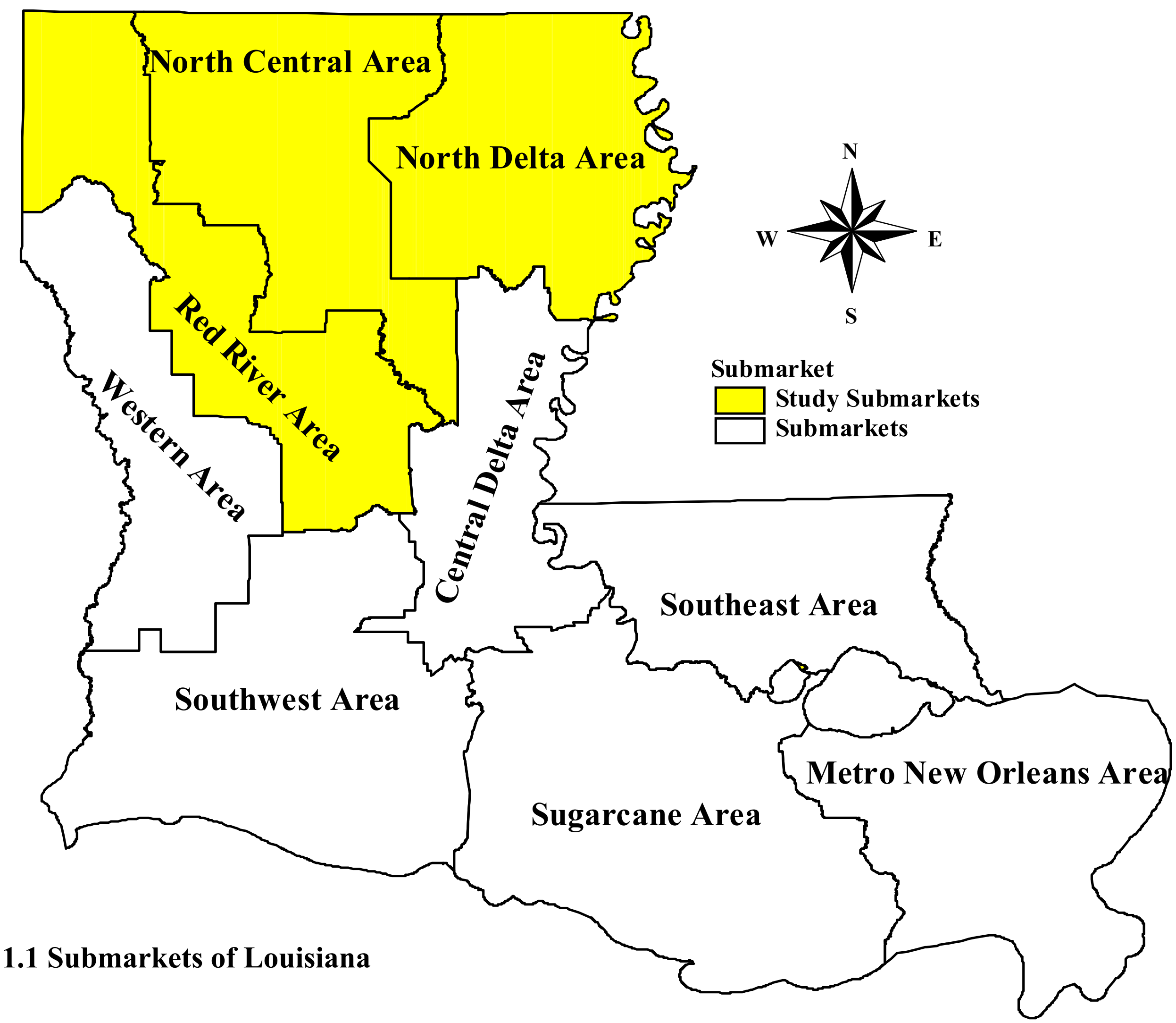

Figure 1.1 Submarkets of Louisiana

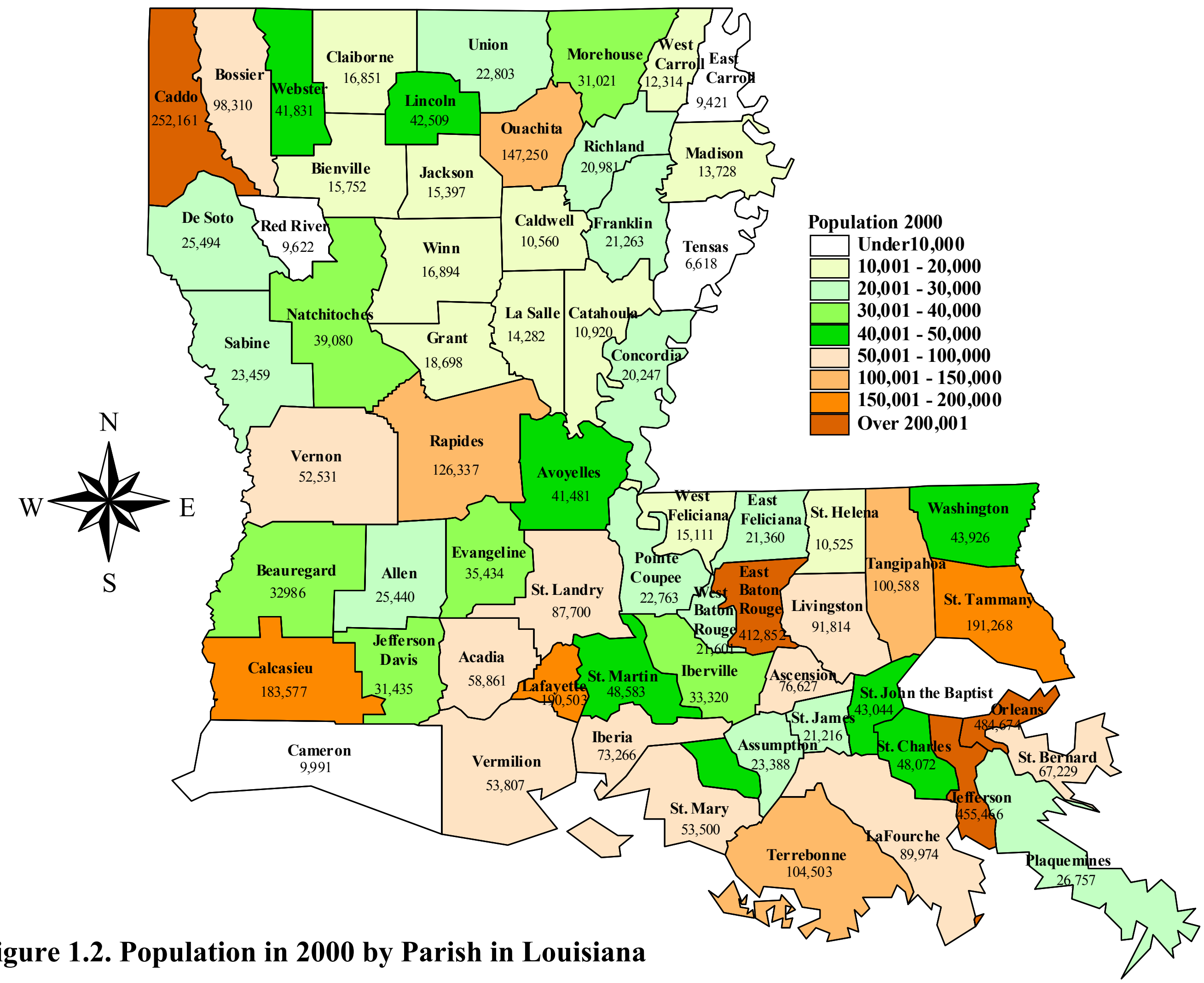

Figure 1.2. Population in 2000 by Parish in Louisiana

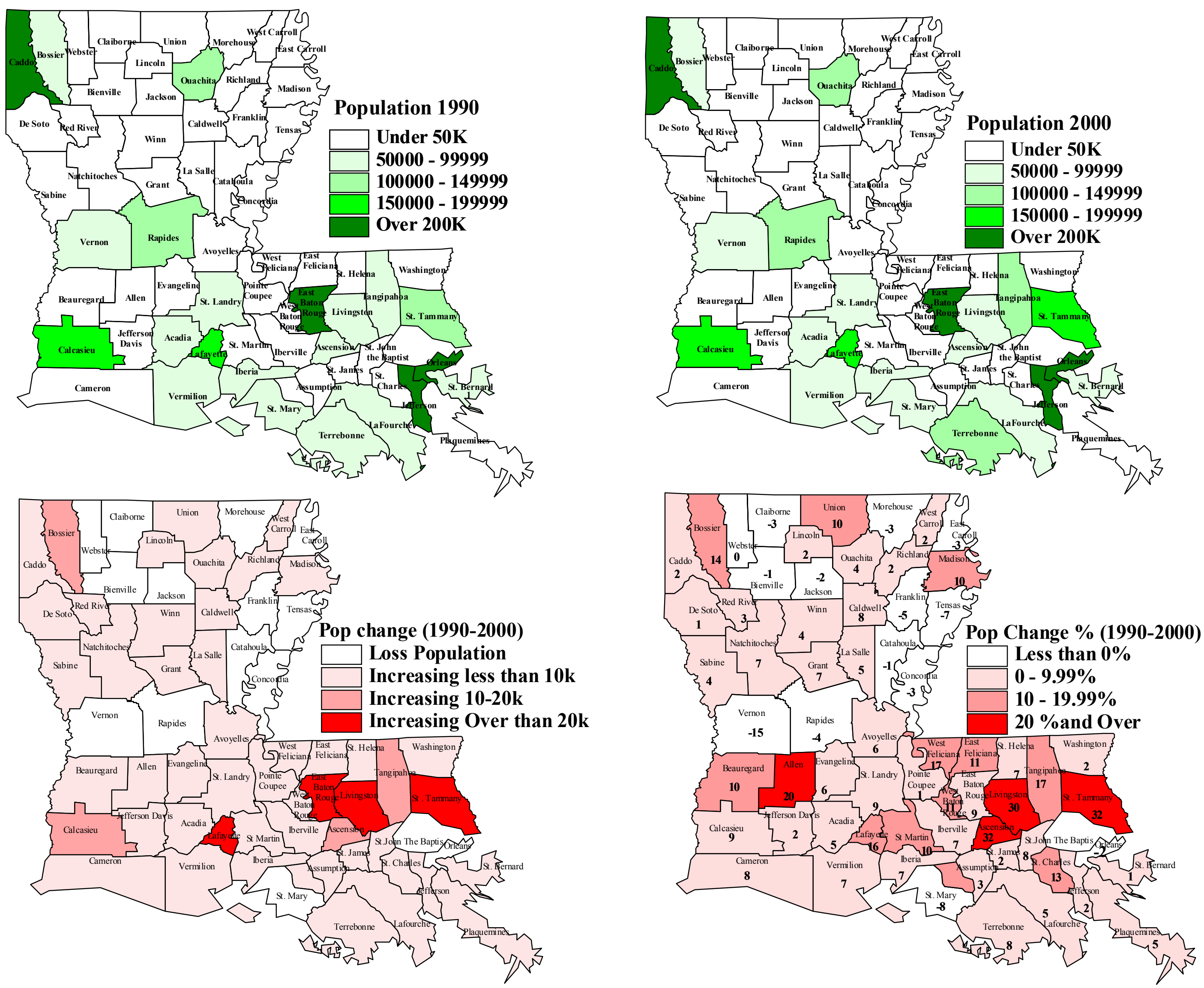

Figure 1.3. Population Comparison from 1990 to 2000 by Parish in Louisiana

Figure 1.3 shows the overall and percentage increases and decreases of population by parish within each submarket in Louisiana. Most of the growth in population in the state has occurred in the southern part of the state with only two of thirty-five parishes in the southern part of the state experiencing a loss in population. In contrast, twelve of the twenty-nine parishes in northern Louisiana experienced a loss in population.

Average per capita income for the three submarkets is $14,000, with the highest per capita income in the Red River submarket ($15,386) and the lowest in the North Delta submarket ($12,665). The highest percentage of persons below the poverty level exists in the North Delta submarket at 29 percent, whereas both the Red River and the North Central submarkets have levels at 22 percent.

Each submarket in northern Louisiana relies heavily on agricultural production. As shown in Figures 1.5 to 1.11, most of the row crop production occurs in the North Delta and Red River submarkets. Most of the timber production occurs in the North Central submarket. Tables 1.1 and 1.2 list the individual crop details of the major agricultural enterprises by submarket and parish.

The North Delta submarket is comprised predominantly of row crop agriculture, featuring cotton, rice, wheat, soybeans and corn production. According to the LSU AgCenter's *2003 Louisiana Summary*, the total valuation of these crops in the North Delta submarket is $457,449,080, followed by timber valued at about $53,959,311 and total cattle value of $27,419,741. The Red River submarket is comprised predominately of both row crop production and timber production. The valuation of timber is greater at a value of $138,089,753, followed by a row crop valuation of $63,173,991 and total cattle

Table 1.1 2002 Agricultural Production Acreage by Submarket for Leading Crop Production

	Corn		Cotton		Rice		Sorghum		Soybeans		Wheat	
Parish by Submarket	Harvest (acres)	Production (Bushels)	Harvest (acres)	Production (Bales)[1]	Harvest (acres)	Production (Cwt)	Harvest (acres)	Production (Bushels)	Harvest (acres)	Production (Bushels)	Harvest (acres)	Production (Bushels)
Red River												
Bossier	2,500	290,000	1,000	1,800					6,000	180,000	5,300	165,000
Caddo	15,800	1,930,000	13,900	27,900					7,100	175,000	3,000	95,000
Grant	2,100	220,000	3,600	3,500			1,100	90,000	5,500	190,000	1,500	65,000
Natchitoches	10,800	1,260,000	12,100	14,200	4,400	234,000	1,000	95,000	11,500	280,000	3,200	105,000
Rapides	6,800	910,000	17,200	26,800	7,500	370,000	5,600	510,000	13,500	430,000	1,700	75,000
Red River	3,100	375,000	5,500	8,700					4,400	100,000	2,400	89,000
Submarket Total	41,100	4,985,000	53,300	82,900	11,900	604,000	7,700	695,000	48,000	1,355,000	17,100	594,000
North Central												
Bienville												
Claiborne												
Jackson												
LaSalle												
Lincoln												
Union												
Webster												
Winn												
Submarket Total	0	0	0	0	0	0	0	0	0	0	0	0
North Delta												
Caldwell	1,400	190,000	8,900	10,200	1,200	60,000			2,800	85,000	1,900	55,000
East Carroll	50,000	6,900,000	27,500	52,400	16,300	1,030,000	2,900	270,000	64,000	2,590,000	11,400	610,000
Franklin	44,700	6,150,000	54,700	71,000			5,400	345,000	21,000	730,000	37,500	1,420,000
Madison	92,500	10,860,000	58,000	90,200	7,000	420,000	6,900	595,000	47,000	1,680,000	6,400	270,000
Morehouse	77,000	9,710,000	57,500	85,700	29,900	1,650,000	10,600	800,000	30,000	830,000	8,700	330,000
Ouachita	3,600	400,000	13,900	18,800	8,200	450,000	1,100	80,000	6,200	160,000	4,900	175,000
Richland	35,700	4,640,000	38,000	41,100	7,100	400,000	6,100	440,000	19,000	610,000	27,800	990,000
Tensas	58,500	6,990,000	74,500	132,500			11,500	1,080,000	18,000	660,000	10,700	380,000
West Carroll	16,600	2,240,000	14,800	20,300	7,400	470,000	7,600	500,000	16,000	570,000	20,500	890,000
Submarket Total	380,000	48,080,000	347,800	522,200	77,100	4,480,000	52,100	4,110,000	224,000	7,915,000	129,800	5,120,000
State Total	560,000	68,320,000	495,000	739,000	535,000	29,400,000	165,000	13,365,000	650,000	20,800,000	220,000	8,800,000

[1] 480-pound net weight bales.

Source: Frank and Crawford,2003.

Table 1.2 2002 Timber Harvest and Value by Submarket for Pine and Hardwood

	Pine Saw Timber		Hardwood Saw Timber		Pine Pulpwood		Hardwood Pulpwood		Pine Chip-n-saw	
Parish by Submarket	Harvest (BF Doyle)	Value (Dollars)	Harvest (BF Doyle)	Value (Dollars)	Harvest (Std. Cord)	Value (Dollars)	Harvest (Std. Cord)	Value (Dollars)	Harvest (Std. Cord)	Value (Dollars)
Red River										
Bossier	29,950,368	$10,289,449	2,402,278	$592,089	34,109	$738,119	43,767	$516,013	4,613	$443,909
Caddo	32,032,739	$11,004,847	2,043,508	$503,663	34,717	$751,276	44,800	$528,192	7,180	$690,931
Grant	11,437,243	$3,929,265	852,016	$209,996	55,154	$1,193,533	10,589	$124,844	4,684	$450,741
Natchitoches	43,876,143	$15,073,649	3,904,085	$962,240	195,344	$4,227,244	45,494	$536,374	1,717	$165,227
Rapides	33,018,963	$11,343,665	2,513,653	$619,540	146,075	$3,161,063	19,775	$233,147	14,595	$1,404,477
Red River	16,757,761	$5,757,129	1,044,708	$257,489	56,434	$1,221,232	17,053	$201,055	1,563	$150,407
Submarket Total	167,073,217	$57,398,004	12,760,248	$3,145,017	521,833	$11,292,467	181,478	$2,139,625	34,352	$3,305,692
North Central										
Bienville	76,387,608	$26,242,963	3,731,686	$919,749	190,397	$4,120,191	51,066	$602,068	5,360	$515,793
Claiborne	63,641,999	$21,864,209	5,217,633	$1,285,990	80,766	$1,747,776	74,754	$881,350	4,887	$470,276
Jackson	38,203,309	$13,124,747	2,904,137	$715,783	169,107	$3,659,475	41,702	$491,667	10,040	$966,149
LaSalle	24,119,734	$8,286,335	1,554,907	$383,238	174,975	$3,786,459	26,393	$311,173	35,435	$3,409,910
Lincoln	22,085,376	$7,587,431	3,325,269	$819,579	62,329	$1,348,800	41,517	$489,485	4,511	$434,094
Union	50,599,981	$17,383,623	4,287,819	$1,056,819	176,867	$3,827,402	71,399	$841,794	39,359	$3,787,517
Webster	39,658,115	$13,624,545	4,982,343	$1,227,998	57,631	$1,247,135	57,193	$674,305	5,654	$544,084
Winn	44,866,321	$15,413,825	5,484,715	$1,351,818	227,906	$4,931,886	45,975	$542,045	33,540	$3,227,554
Submarket Total	359,562,443	$123,527,678	31,488,509	$7,760,974	1,139,978	$24,669,124	409,999	$4,833,887	138,786	$13,355,377
North Delta										
Caldwell	8,243,306	$2,831,988	3,523,378	$868,407	115,624	$2,502,103	32,901	$387,903	17,880	$1,720,592
East Carroll			1,327,764	$327,254			15,104	$178,076		
Franklin	402,449	$138,261	1,165,108	$287,164	680	$14,715	5,677	$66,932	10	$962
Madison			6,939,201	$1,710,305			29,580	$348,748		
Morehouse	27,615,236	$9,487,214	1,251,671	$308,499	42,543	$920,631	23,553	$277,690	11,537	$1,110,206
Ouachita	10,251,779	$3,521,999	2,341,689	$577,156	39,636	$857,723	29,699	$350,151	16,046	$1,544,107
Richland	79,533	$27,324	2,034,616	$501,472	3,112	$67,344	12,626	$148,861		
Tensas			2,177,782	$536,758			10,895	$128,452		
West Carroll			935,057	$230,463			16,001	$188,652		
Submarket Total	46,592,303	$16,006,786	21,696,266	$5,347,478	201,595	$4,362,516	176,036	$2,075,465	45,473	$4,375,867
State Total	1,006,166,745	$343,303,428	148,183,723	$36,522,840	3,567,601	$77,202,887	1,378,891	$16,257,122	853,203	$82,103,723

Source: Louisiana Department of Agriculture & Forestry

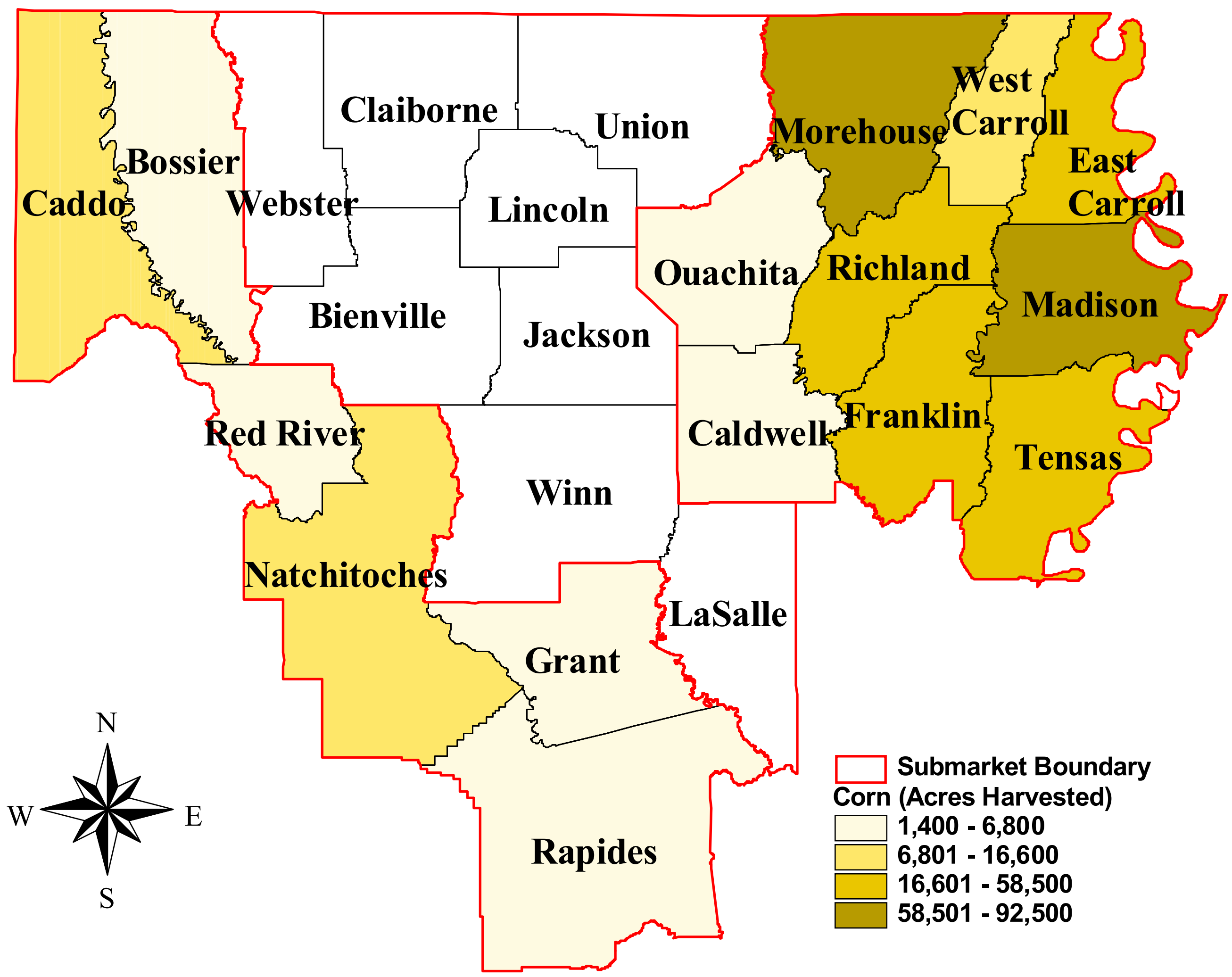

Figure 1.4. Corn Production in Northern Louisiana

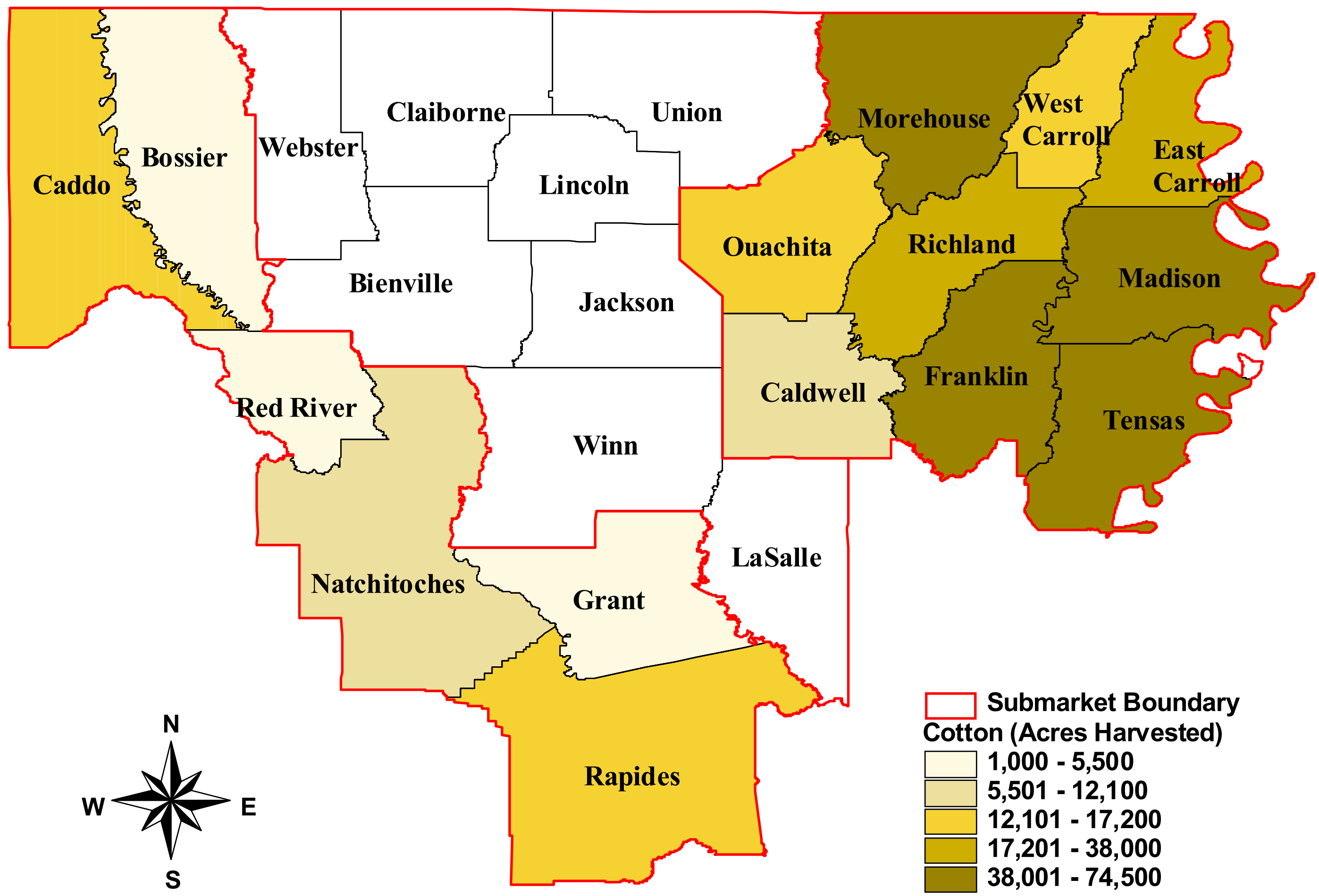

Figure 1.5. Cotton Production in Northern Louisiana

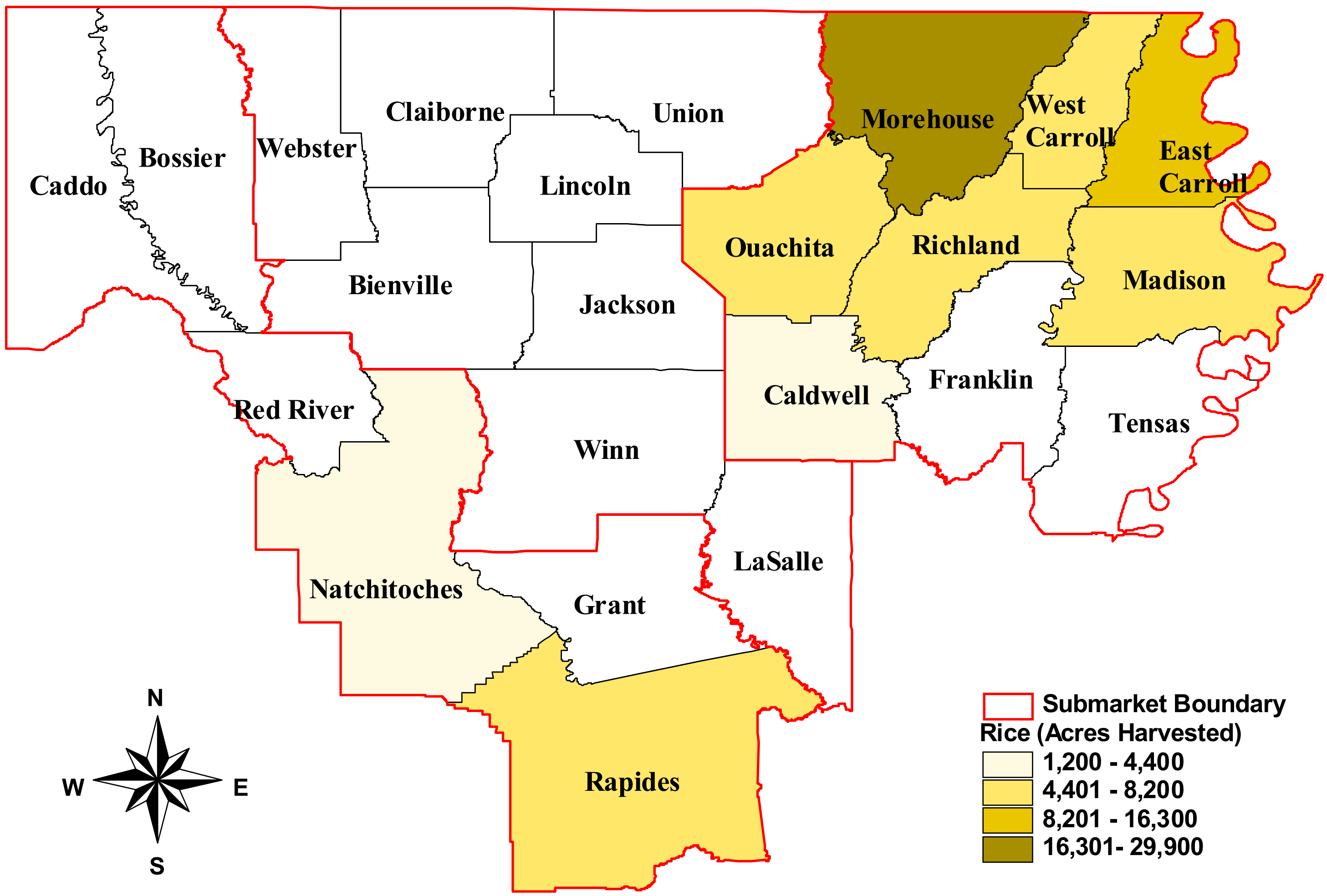

Figure 1.6. Rice Production in Northern Louisiana

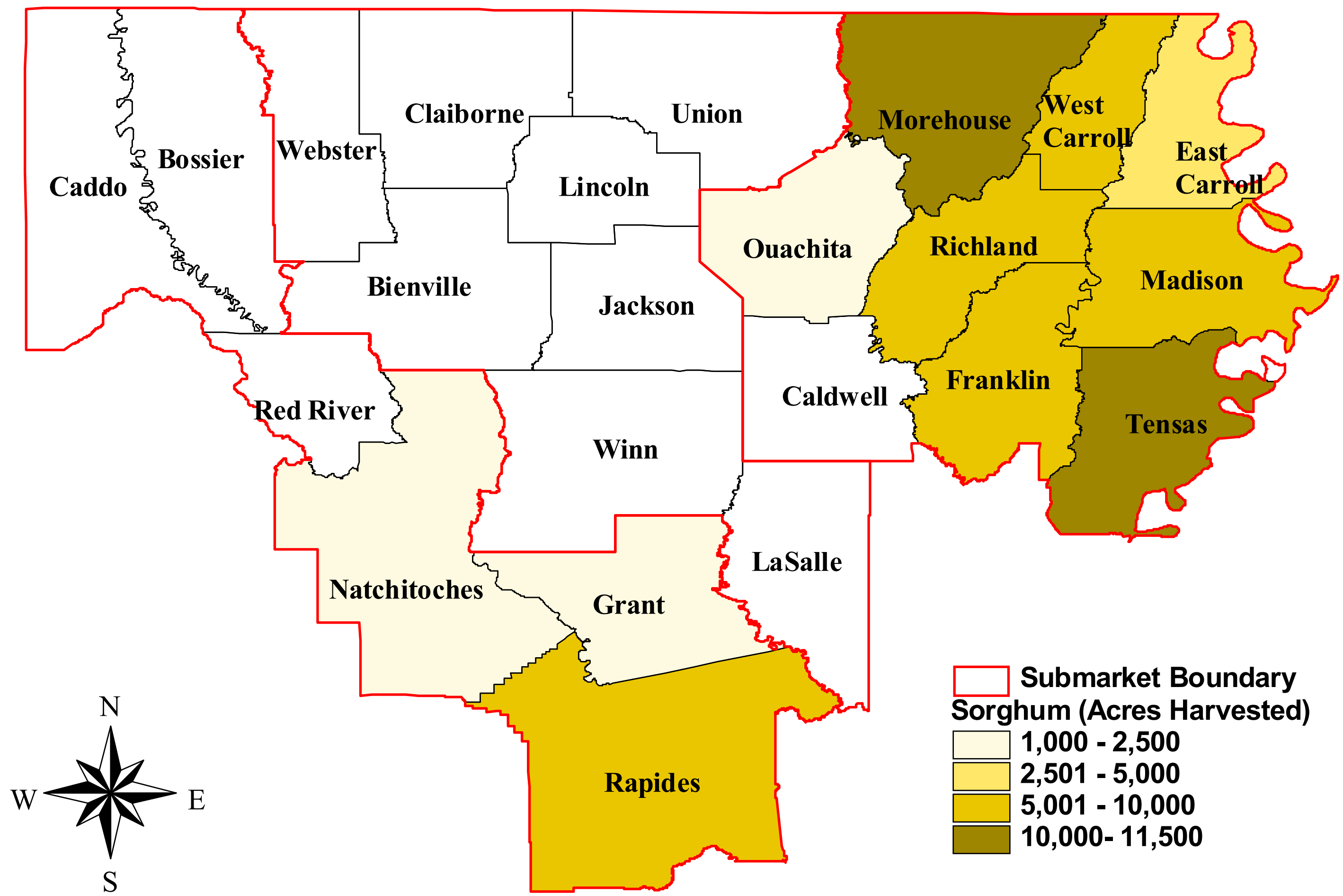

Figure 1.7. Sorghum Production in Northern Louisiana

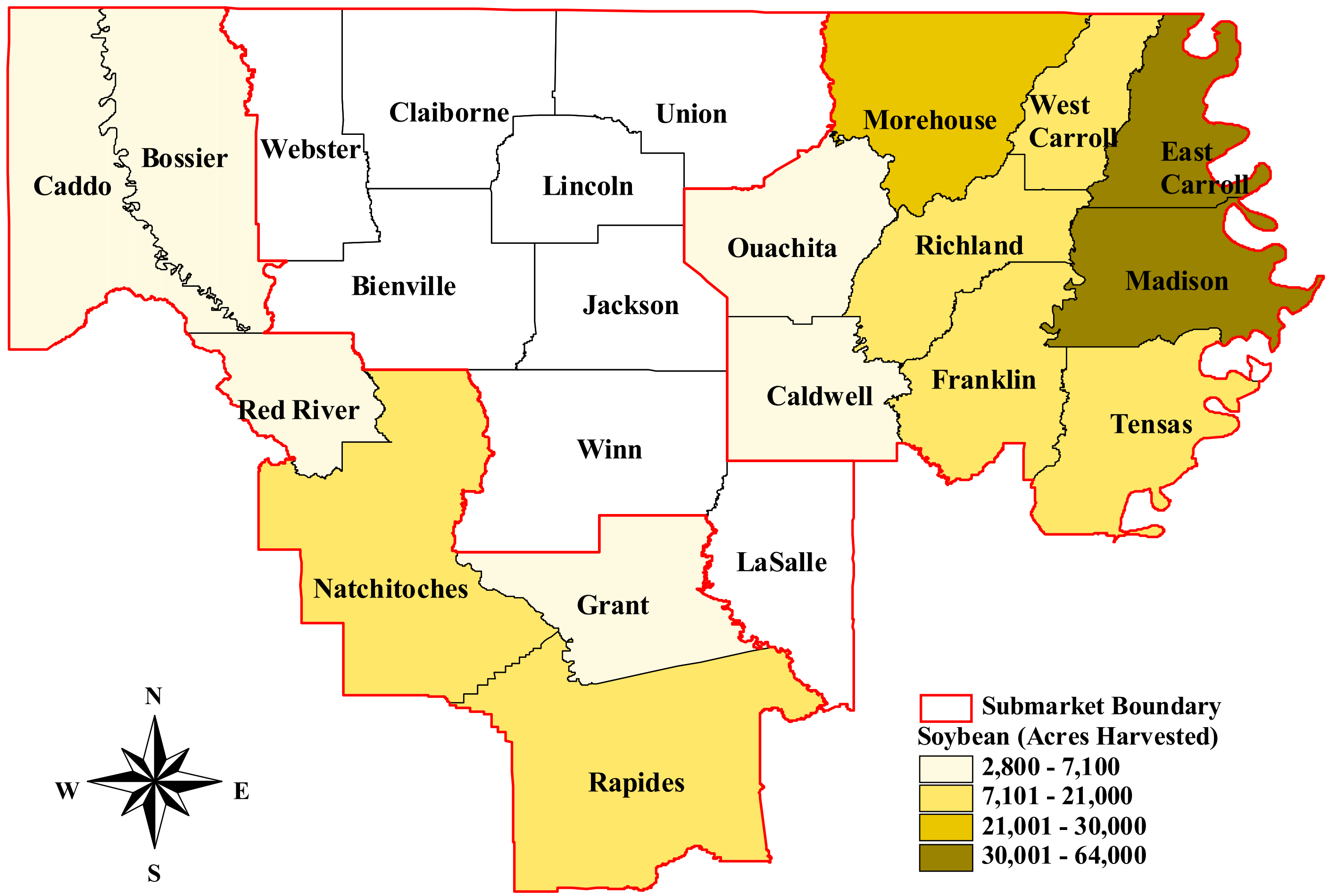

Figure 1.8. Soybean Production in Northern Louisiana

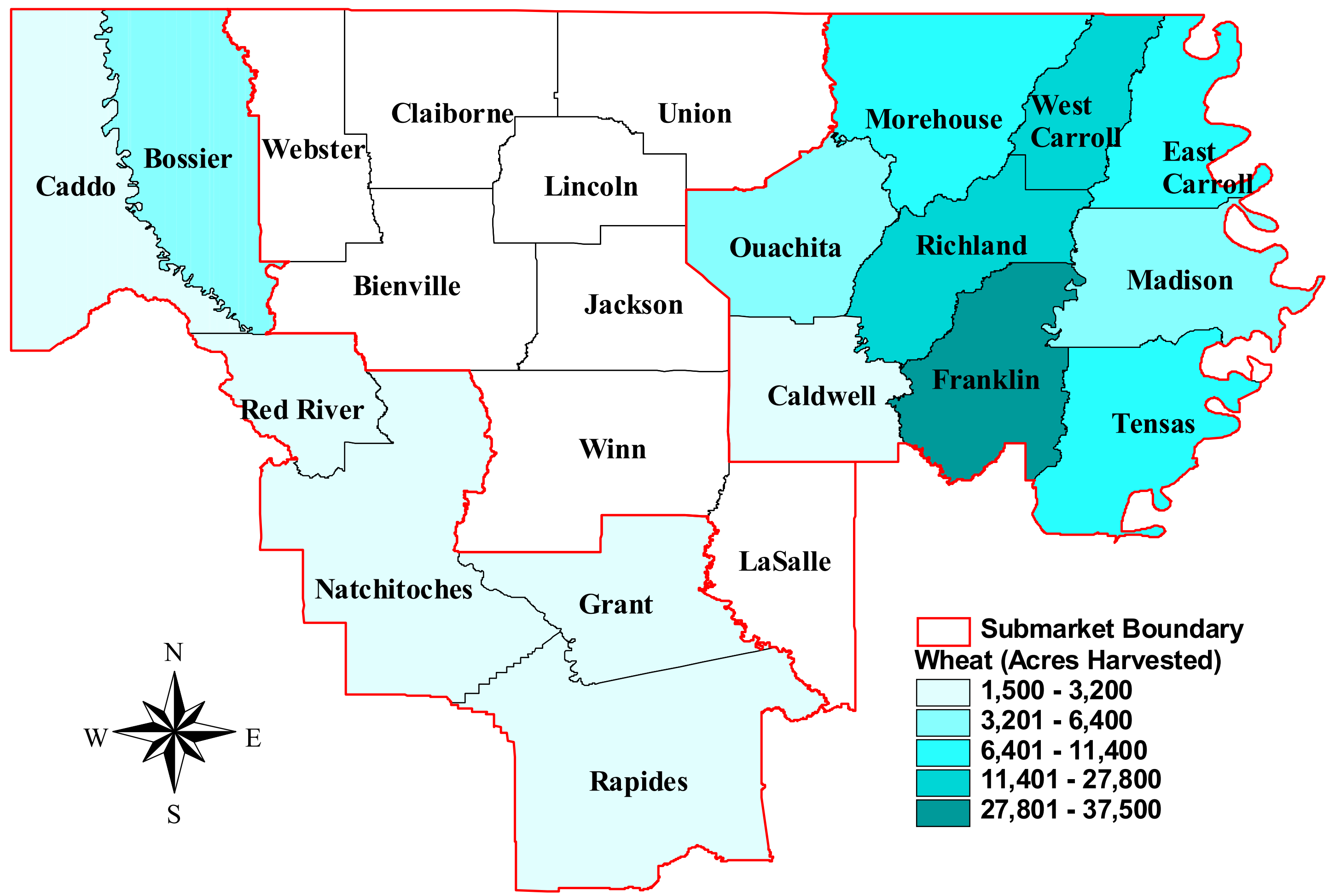

Figure 1.9. Wheat Production in Northern Louisiana

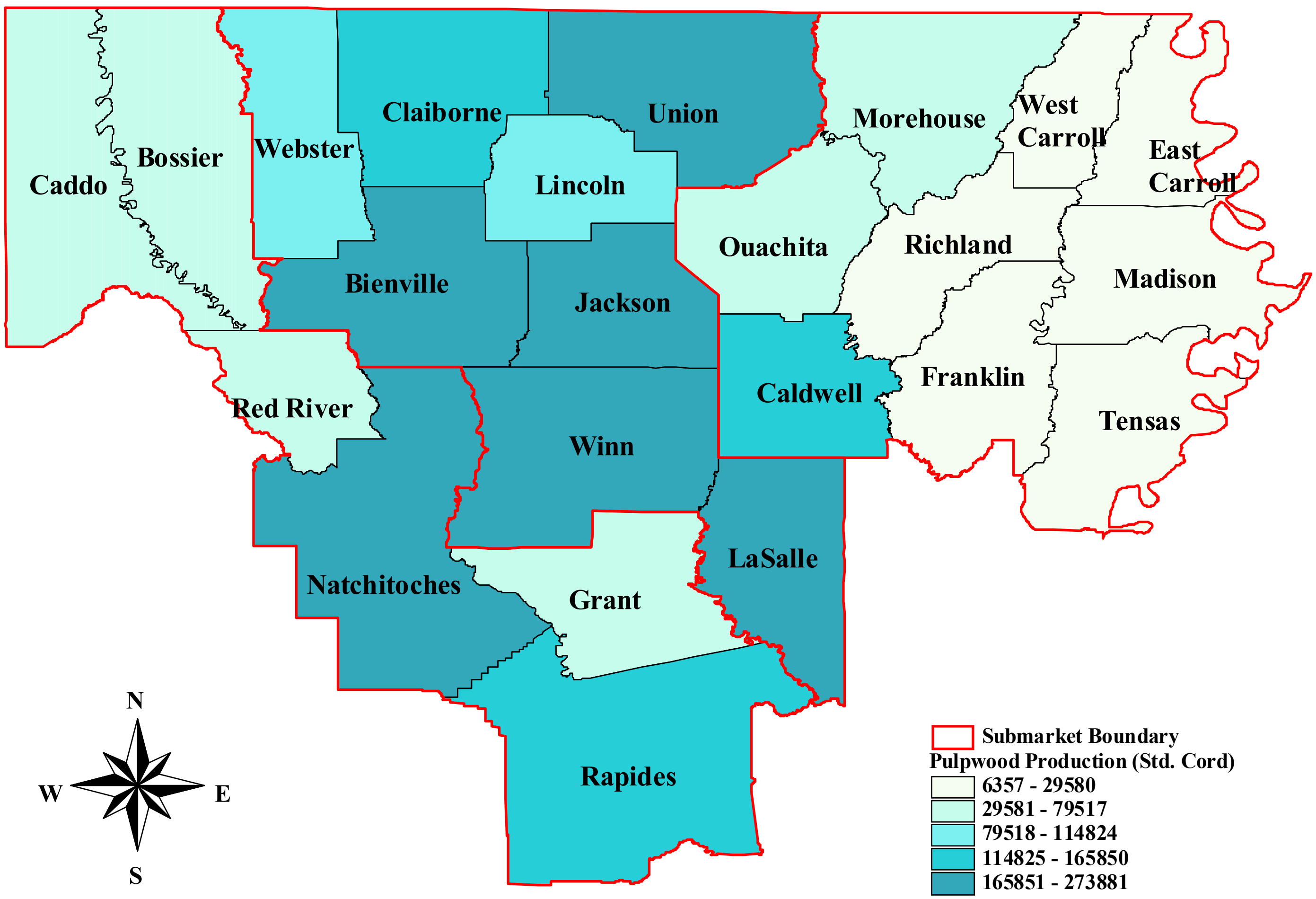

Figure 1.10. Pulpwood Production in Northern Louisiana

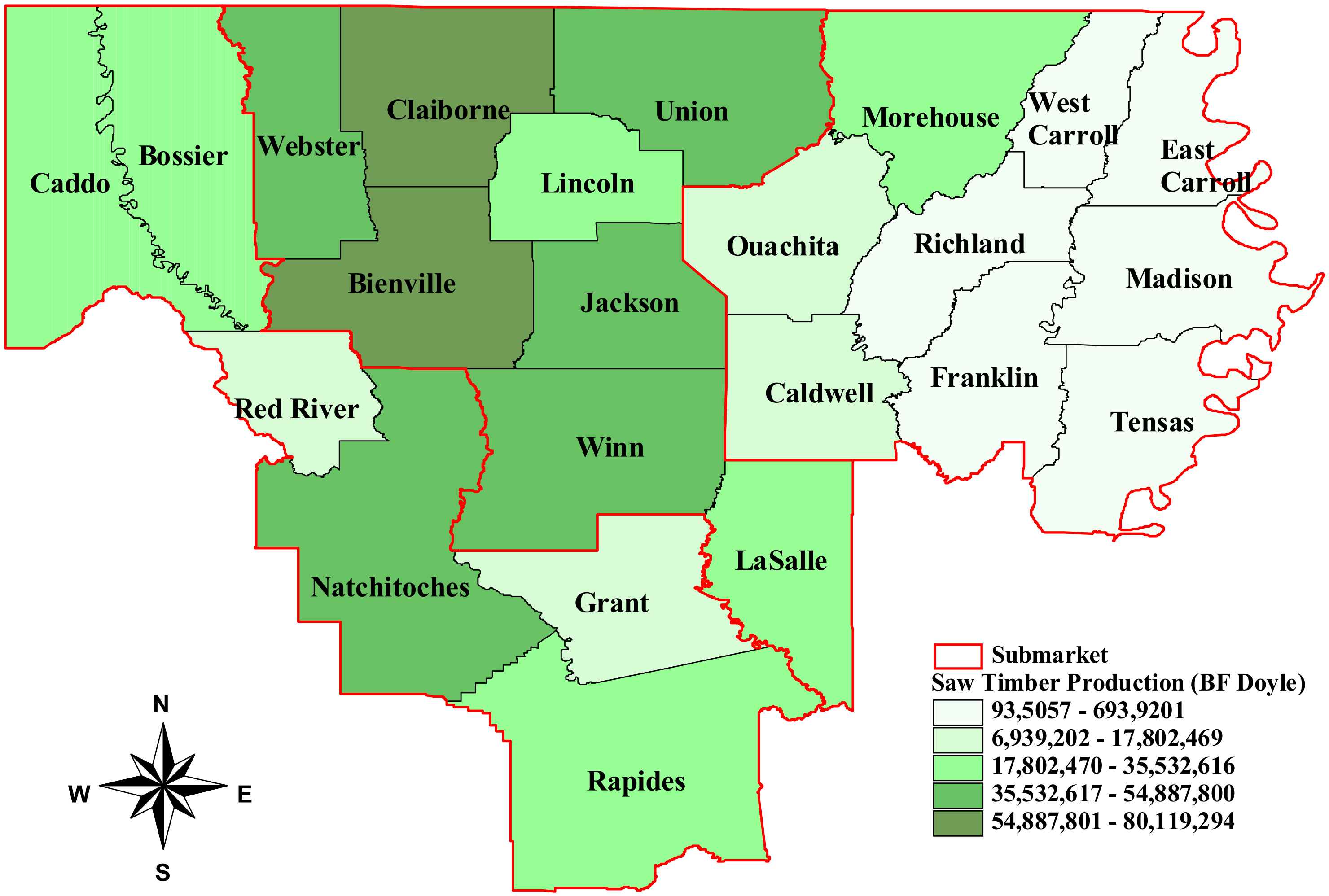

Figure 1.11. Saw Timber Production in Northern Louisiana

value of $50,298,659. Geographically, the North Central submarket separates the other two submarkets and has a much higher proportion of timber production. The total timber valuation is estimated to be about $319,782,255 followed by total cattle value of $21,434,280 and row crop production valued at $751,190.

These submarkets consist primarily of rural agricultural land. However, major Metropolitan Statistical Areas (MSAs) are located on the fringe of these submarkets and have potential for influencing the land market as they encroach on the rural areas (Figure 1.12). The MSAs include Shreveport, Alexandria, and Monroe and are dispersed in a triangular form within the submarket boundaries. Similarly, the effect of being located near a town, though not classified as an MSA, should also have the potential for influencing land values. There are several less populous locations throughout this region that are not as large as the designated MSAs that will be analyzed to determine if they have any significant impact on rural land value. The towns used in this study are indicated on Figure 1.13 and are most often also the parish seat.

Along with the diversity in agricultural production that exists among the submarkets, there also exists diversity in soil classification of the region. Further discussion detailing the different soils that comprise each submarket will be presented later. It is reasonable to believe that soil characteristics and type can affect land values, especially in a region that relies so heavily on the productivity of soil. The North Delta submarket is made up predominantly of Southern Mississippi Valley Silty Uplands and Alluvium soils. The North Central and Red River submarkets are made up of mostly of Western Tertiary Uplands-Uplands soil. Definitions of these soil types will follow.

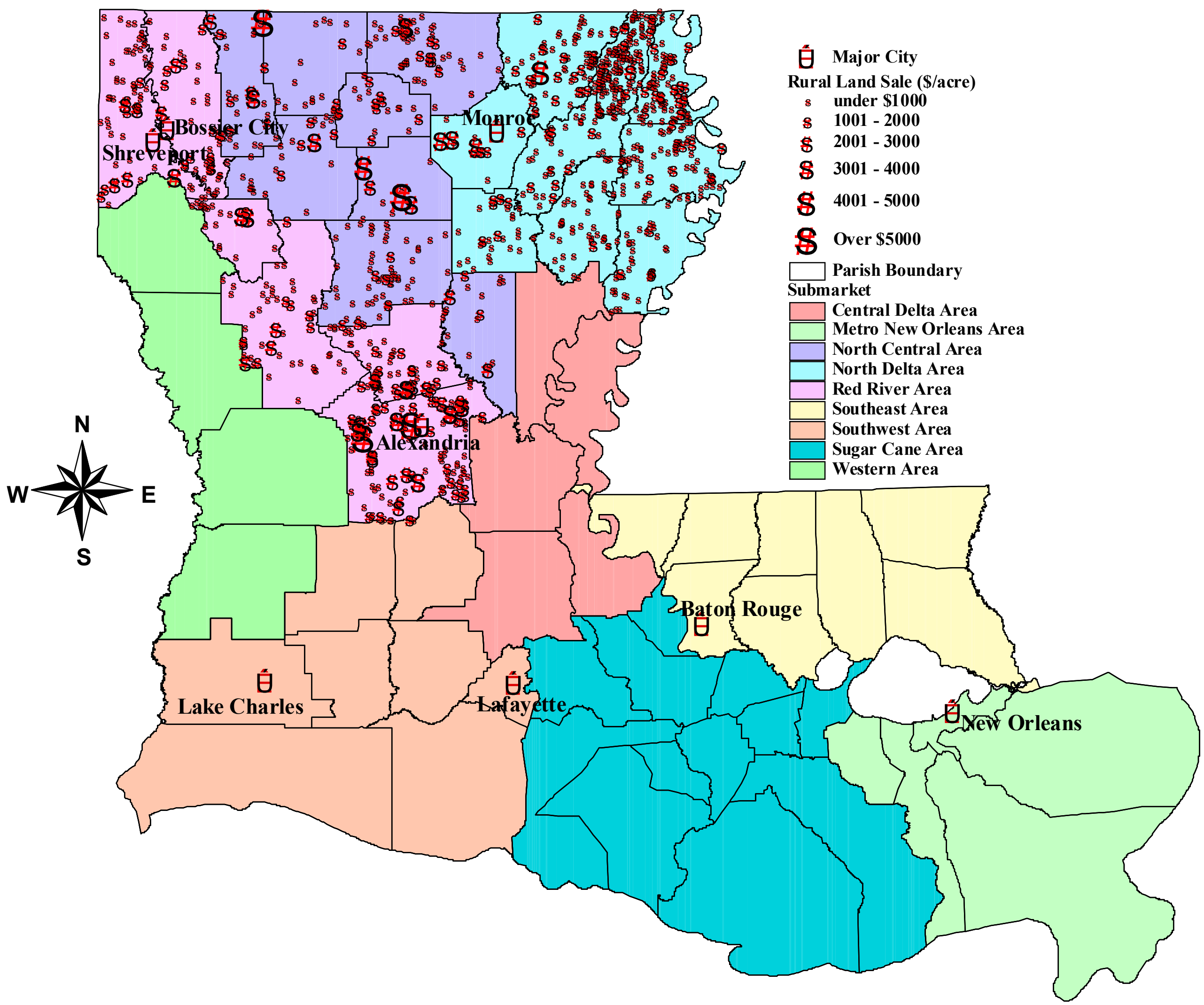

Figure 1.12. Northern Louisiana Land Sales by Submarket including MSAs

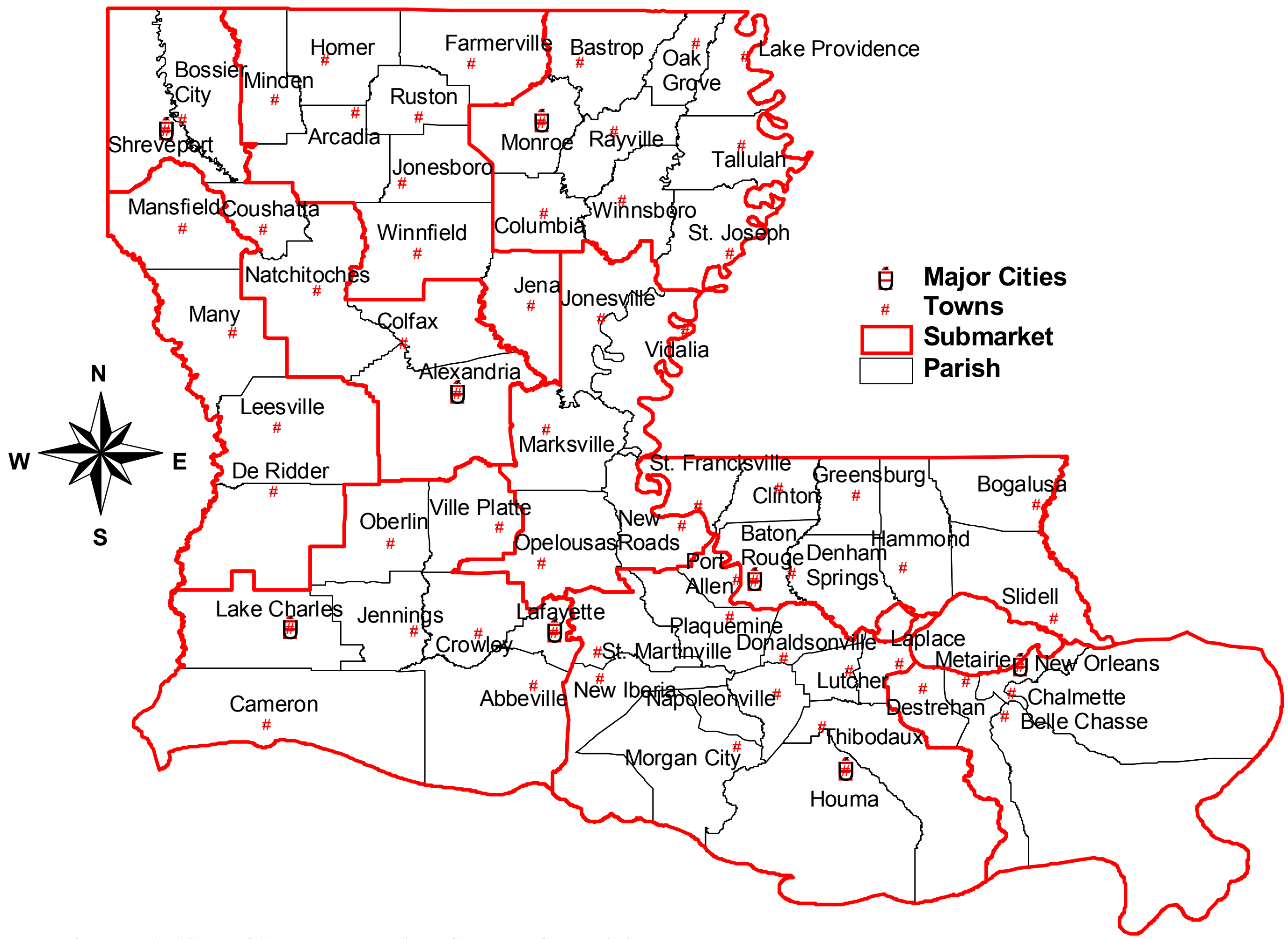

Figure 1.13. MSAs and Parish Seats of Louisiana

Problem Statement

Agricultural production comprises much of the economic viability of northern Louisiana. Because land value as a capital asset of the agricultural production sector is so great, a better understanding of how rural land is valued and what characteristics impact this asset are essential to determining the dynamic worth of the agricultural sector. As more information about how land is valued becomes available, one would expect that the marketplace would improve and become more efficient. Because large agricultural land tracts are not traded with tremendous frequency, improving the information available to potential buyers and sellers has the benefit of making the marketplace more effective.

Through the process of gathering information about land sales that have taken place in northern Louisiana, specific characteristics and influences have been identified that help to further explain what comprises the final price of an acre of land. Once identified, the effects of these characteristics and influences can be quantified to determine the marginal impact they have on land value. Individual quantification of specific characteristics and influences can provide assistance to valuing other land tracts in similar geographic regions that may exhibit certain characteristics that have previously been studied. The purpose of this research is to identify and quantify those characteristics and influences that effect land values significantly in order to better understand land valuation and to determine whether there are distinguishing differences among submarkets regarding attributes specific to land and other attributes, including socioeconomic factors.

Justification

Factors that affect rural real estate are important to study for several reasons. Largely rural real estate comprises a large portion of the overall farm budget. For those who depend on this land as a means of income, factors effecting this investment are highly valuable. Rural real estate is the foundation for many small communities and is the basis for not only the farming and ranching community but also the banking and commercial community as well. As an investment that does not frequently exchange hands, rural land can at times be difficult to value. For this reason, rural land value research plays an important role in identifying characteristics and factors that affect the value of land.

In the history of research that has been conducted within the rural land value data base, there have been much information and insight added into understanding the market for land and the factors that affect the sale of land. This research has been instrumental in developing a better understanding of how environmental, locational, and spatial factors affect land values. Much of the research that has been published has focused largely in the southern part of Louisiana. This body of research deals with the three submarkets that comprise the northern part of the state. The purpose for choosing this region is to broaden the understanding of how certain characteristics and influencing factors affect land values in this part of the state.

There have been various studies done analyzing rural land values within Louisiana. In the research of Kennedy (1995), individual submarkets were established and initial data analysis was conducted regarding the northern three submarkets. Individual submarkets have also been studied from the standpoint of a particular attribute, for example, sugarcane production within the sugarcane submarket (Breaux 1999). Soto (2004) conducted a spatial analysis of the Louisiana rural land sales data set incorporating spatial econometrics. However, there has been no specific study on the submarkets of northern Louisiana.

This study is important because it offers a detailed analysis of each of the three northern submarkets incorporating land sale characteristics as obtained by the surveys conducted, socioeconomic variables including population and poverty level information, and spatial information from GIS sources. This analysis is differentiated on the basis of location and by the fact that it incorporates socioeconomic variables directly. The implications of this study can be far reaching and can provide some insight as to what affects rural land in the northern part of Louisiana.

Research Objectives

Fluctuations in the value of rural real estate have a substantial impact on capital structure and income in Louisiana's agricultural production sector. The general objectives of this research are to identify and estimate factors affecting these values, quantifying the contribution of individual characteristics of property and providing better information on the value of land capital assets for rural properties in North Louisiana. Better market information on the characteristics that affect rural land value will benefit both buyers and sellers in that market.

The specific objectives are to:

1) Develop a statistical model of agricultural land sales for the Red River, North Central, and North Delta submarkets of Louisiana;

2) Derive implicit marginal values for statistically significant characteristics in the model; and

3) Discuss the implications of the model results for future rural land sales in these submarkets.

The remainder of this work provides a discussion of the literature on land value studies and a discussion of the methods and procedures used, including the hedonic pricing model used in this study. That will be followed by a discussion of the data available for the study and variables expected to be included in the model analysis. This study concludes with a discussion of results found.

Research Procedures

Objective One

Previous research has established the hedonic model as the appropriate method to use when estimating the value of land based on underlying attributes of the land. The hedonic model which is used often in land value economics is designed to group varying characteristics together into one marketable good; thus, the total value of all the underlying characteristics comprise rural land value in this case. For example, as applied to rural land values, value would be determined by the characteristics that make up that land which might include total number of acres, presence of water, presence of crops or timber, or whether or not there is road access, just to name a few. All of the characteristics as defined by the data and those that indirectly affect land values, such as population, are grouped together to determine the value of an individual parcel of land.

Rosen (1974) developed the hedonic modeling method that is basis for this kind of economic research. He defined hedonic prices as implicit prices of attributes. These prices have to be calculated and are considered implicit because there is no direct market for them. This can be illustrated in an example of a tract of land that has environmentally good attributes and a tract of land that has environmentally bad attributes. While there is no direct market for environmental attributes, one would expect that the land in the bad environment would be valued for less that the other tract of land. Thereby the attributes of the implicit characteristic, environmental quality, in this example have an impact on land values, holding all other characteristics constant.

The model used by Kennedy (1995) allows the estimation of individual attributes that comprise the total value of a tract of land. The following model was developed for use in analyzing the rural land data set in Louisiana:

$$P = \beta_0 Z_1{}^{\beta_1} \exp\left[\sum_{i=1}^{m} \alpha_i X_i + \sum_{j=1}^{n} \gamma_j D_j + \varepsilon \right]$$

where P is price per acre of land, Z is the size of the tract of land in acres, m is the number of additional continuous variables, X, n is the number of discrete variables, D, and Є is the error term. Because as tract size increases, the price per acre of land is expected to decrease at a decreasing rate suggesting a nonlinear relationship. The log of the above model is taken on both sides, resulting in the following equation:

$$\ln P = \ln \beta_0 + \beta_1 \ln Z_1 + \sum_{i=1}^{m} \alpha_i X_i + \sum_{j=1}^{n} \gamma_j D_j + \varepsilon$$

Previous research has shown some significant characteristics of land to be percent cropland, percent timberland, percent pastureland, value of improvements, general soil type, size of tract, distance to nearest town or major city measured in both time and miles, as well as road access and road frontage.

Objective Two

Implicit marginal prices of each characteristic are defined as an estimate of change in per acre land price brought about by a one-unit change in that characteristic. For continuous variables, the partial derivatives, which are the marginal prices, are as follows:

$$\delta P_t / \delta Z_{1,t} = IZ_{1,t} = \left[\beta_1 / Z_{1,t}\right] P_t$$

$$\delta P_t / \delta X_i = IX_{I,t} = \alpha_i P_t$$

where IZ is the implicit price per acre of land and IX is the marginal change in the continuous variable. The t subscript indicates that there are implicit prices associated with each transaction. To estimate the implicit marginal price at the mean price and mean level of the characteristic over all observations, the mean value of each variable must be substituted into the equation (Kennedy, 1995).

The derivative for discrete variables is estimated in semilogarithmic equations using the variance of the discrete variable (Kennedy, 1981):

$$ID_j = (\exp [\ c_j - ½\ V(c_j)\ ] - 1\ )\ \text{mean price},$$

where ID_j is the implicit price of the discrete variable, c_j is its estimated coefficient, $V(c_j)$ is the variance of the c_j, and mean price is the mean price per acre over all of the observations used in the model. Using the variance of the estimated coefficient can lead to less bias in the estimate when $V(c_j)$ is substantial.

Objective Three

It is hypothesized that there will be several significant characteristics that affect rural land values. Among these, it is also hypothesized that socioeconomic characteristics will have a significant effect on land values. These characteristics will be discussed and implications of this study will be reviewed regarding the impact they have on all those who are impacted by the rural land valuations.

Organization of the Thesis

This study is divided into five chapters. Chapter one includes the introduction, problem statement, justification, objectives, and general procedures. Chapter two includes theory and literature review on economic theory to support the analysis presented in this research. Chapter three includes the methods and procedures used to analyze this data as well as a discussion of the variables that will be used in estimation. Chapter four presents a discussion of the results from the models run for this study, and chapter five discusses the findings and conclusions and provides implications and recommendations for the results.

CHAPTER 2

LITERATURE REVIEW

Average value per acre including buildings of farmland in Louisiana as of 2002 was $1,100 for irrigated cropland, $1,250 for non-irrigated cropland, and $1,200 for pastureland. Louisiana had 8.05 million acres in farms in 2002 (Frank and Crawford, 2003). The price statistics result from the study of the buying and selling of land in Louisiana. The most basic understanding of economic theory relies on the understanding of markets: markets of supply and those of demand.

In regard to valuing land based on its characteristics, early research by Downing (1973) suggested that land could be valued based upon its underlying characteristics. He also hypothesized that these underlying characteristics comprised selling prices of parcels of land which were better measures of price than assessed values.

Previous literature has indicated that hedonic pricing of goods has been examined for some time. Earliest studies lacked a theoretical model that could be used for empirical analysis. In 1974, however, Rosen's article transformed the body of research that existed to that point by introducing a theoretical framework that has been used predominantly in research of this kind ever since. Rosen defined hedonic or implicit prices as "observed product prices and the specific amounts of characteristics associated with each good." Rosen proposed that the theory of hedonic prices ultimately stated that final prices of goods are a function of the characteristics that comprise the good. He also went on to say that these characteristics can be observed and quantified and these quantifications make up the hedonic prices of goods. Rosen also proposed the two-stage process that is widely used throughout the literature. The two-stage process begins by estimating a good's price over all its characteristics using the best fitting functional form. Marginal implicit prices can then be calculated by taking the partial derivative of price with respect to each of the characteristics. Finally, the second stage simultaneous estimation requires that the estimated marginal prices be used as endogenous variables (Rosen, 1974).

Chicoine (1981) utilized the hedonic pricing approach when evaluating farmland prices on the urban fringe of Chicago. His work is important as it demonstrated the use of hedonic pricing theory as it relates specifically to valuing land through some of its underlying characteristics. Of particular interest in his study is the characteristic of distance to nearest major metropolitan area, which was used in place of time. This characteristic was found to be of key significance in the results section of his article.

In research conducted by Miranowski and Hammes (1984), they showed that characteristics referring to land quality are also of importance in valuing land and especially farmland. It had been observed that land of "poorer" quality was being assessed at a similar value of land that is of "better" quality as determined by the amount of topsoil. It was their aim to emphasize that soil quality is of importance in valuing land and should be reflected in selling prices. One of the disadvantages of the appraisal technique of valuing land is that it relies on the values of other neighboring parcels of land. In order to remove the bias that exists from this technique, Miranowski and Hammes used the implicit prices approach to determine land value.

While Downing and Chicoine both studied land values using a hedonic framework, it is with the work of Palmquist in 1989 that a detailed model was developed for estimating land values using a hedonic pricing approach. Palmquist wanted to confirm that characteristics involving land quality and productivity were influential in determining land prices. His modeling did show that the characteristics of land were important and should provide insight in determining pricing schedules of land.

Of note in later research that is being conducted are studies of land valuation using the technology of GIS (Geographic Information Systems). Through the use of such technology Paterson and Boyle (2002) conducted their research of land valuation based on the visibility variables of the parcels. They found that areas that had pleasing views, for example, areas overlooking a lake or other recreational resource, were valued higher than if the view was of some commercial or industrial sight. In their study, close proximity to commercial areas was important, but when there was visibility of the commercial area land values were lower. Implication of their work could effect site changes in areas where commercial and residential properties are in the same vicinity. Their work is influential in further identifying characteristics that effect land values.

The identification of variables that affect the value of land is an ongoing process. In recent work completed by Reynolds and Regalado (2002), they discussed the impact of land being classified as wetland. They found that generally land classified as wetlands has a negative impact on land values. Because of the general negative implication associated with land that is classified as wetland there have been some reservations on the part of land owners to have their land delineated as federal wetland. This conclusion supports the hypothesis of this research regarding land that floods, which is that flooding negatively affects the value of land. While land that floods may not be classified as wetlands, one would expect that either classification would have a negative effect on land values. Other characteristics that they found to have a positive significant influence on land values was the presence of irrigation systems, the presence of buildings, and access to road frontage.

Research identifying characteristics of land and the value that these provide to the composition of total land value are significant to the further understanding of the marketplace for land. It seems reasonable to continue this body of research by further identifying significant characteristics that add to land value. Identifying these characteristics that motivate supply and demand forces in the marketplace provide a more informed and efficient market overall.

CHAPTER 3

METHODS AND PROCEDURES

Hedonic Pricing Model

Hedonic regression provides a means of estimating the effects of the various characteristics of rural land in determining land value. The hedonic approach allows the estimation of individual parcel attributes or characteristics. Historically, rural land market studies have reported that the relationships between rural land prices and various land attributes are nonlinear (Kennedy, 1995).

In the first stage, the hedonic model is estimated and the implicit prices of the characteristics are calculated using the partial derivative of the hedonic equation with respect to each characteristic ($\delta P_t / \delta z_i$). The first-stage of the hedonic model provides only point estimates of the marginal prices based on the quantity of the characteristic and the price per acre paid in the reported transaction. The values are relevant only for these transactions; therefore, no direct implications can be drawn from them (Kennedy, 1995). The direction and magnitude of influence of the characteristics are observable by examination of the implicit prices at the mean values of the rural land price and characteristic quantity. A positive coefficient and implicit price indicate that an increase in the characteristic results in an increase in the price of rural land, and a negative coefficient and implicit price indicate an increase in the characteristic results in a decrease in the price of rural land. Using the estimated coefficients from the first stage of the hedonic model and mean levels of the prices and characteristics, the mean marginal implicit prices for rural land characteristics can be estimated.

In previous studies the second stage was estimated in which the inverse demand is estimated for specific characteristics such as income and other socioeconomic variables which are hypothesized to explain the demand for the characteristic. There is an assumption made that the market-clearing price, P(z), will be determined by the simultaneous interaction of the bid and offer functions, but given the inelasticity of land bid functions are sufficient (Freeman, 1979). In this study, socioeconomic and income variables are estimated directly in the first stage to see if there is a direct impact on rural land values.

First Stage Hedonic Model

Rosen's (1974) two-stage hedonic pricing model was used by Kennedy (1995) to derive coefficients for the characteristics of rural land. The following hedonic model was specified for the Louisiana rural land market by Kennedy:

(1)
$$P = \beta_0 Z_1^{\beta_1} \exp\left[\sum_{i=1}^{m} \alpha_i X_i + \sum_{j=1}^{n} \gamma_j D_j + \varepsilon\right]$$

where P is price per acre of land, Z is the size of the tract of land in acres, m is the number of additional continuous variables, X, n is the number of discrete variables, D, and , is the error term.

Since the price of land is hypothesized to decrease at a decreasing rate as tract size increases (suggesting a nonlinear relationship), we take the natural log of both price and parcel size in the equation, yielding the following:

(2)
$$\ln P = \ln \beta_0 + \beta_1 \ln Z_1 + \sum_{i=1}^{m} \alpha_i X_i + \sum_{j=1}^{n} \gamma_j D_j + \varepsilon$$

Marginal Implicit Prices of Characteristics

The implicit marginal price of each characteristic is an estimate of change in per acre land price brought about by a one-unit change in that characteristic. For continuous variables, the partial derivatives, which are the marginal prices, are as follows:

(3) $$\delta P_t / \delta Z_{1,t} = IZ_{1,t} = \left[\beta_1 / Z_{1,t}\right] P_t$$

$$\delta P_t / \delta X_i = IX_{I,t} = \alpha_i P_t$$

where IZ is the implicit price per acre of land and IX is the marginal change in the continuous variable. The t subscript indicates that there are implicit prices associated with each transaction. To estimate the implicit marginal price at the mean price and mean level of the characteristic over all observations, the mean value of each variable must be substituted into the equation (Kennedy, 1995).

The derivative for discrete variables is given in semilogarithmic equations using the variance of the discrete variable (Kennedy, 1981):

(4) $$ID_j = (\exp [\ c_j - ½\ V(c_j)\ ] - 1\ ) \text{ mean price},$$

where ID_j is the implicit price of the discrete variable, c_j is its estimated coefficient, $V(c_j)$ is the variance of the c_j, and mean price is the mean price per acre over all of the observations used in the model. Using the variance of the estimated coefficient can lead to less bias in the estimate when $V(c_j)$ is substantial.

The Study Area

The study area includes varied topography and soil classifications. The Red River and North Central submarkets have similar soil classifications whereas the North Delta submarket has more varied soil classifications. One reason for this difference is that the North Delta submarket is bordered on the eastern side by the Mississippi River. There are however a few rivers that run through the submarkets including both the Red River and the Ouachita River and countless streams and bayous. Much of the water that makes up northern Louisiana has helped to create the rich soil that is the basis of agricultural production.

Each of the soil classifications that make up these submarkets will be discussed as soil classification can play an important role in how land is valued. Figure 3.1 shows the soil topography of the region. The Red River submarket is characterized by four main soil classifications which include: Western Tertiary Uplands- Uplands, Western Pleistocene Terraces- Terraces, Western Pleistocene Terraces- Floodplains, and Red River Valley Alluvium- Natural Levees. The North Central submarket is characterized by three main soil classifications which include: Western Tertiary Uplands- Uplands, Western Pleistocene Terraces- Terraces, and Western Pleistocene Terraces- Floodplains. The North Delta submarket is characterized by six main soil classifications which include: Western Tertiary Uplands- Floodplains, Eastern Pleistocene Terraces- Terraces, Southern Mississippi Valley Silty Uplands- Uplands, Southern Mississippi Valley Silty Uplands- Floodplains, Southern Mississippi Valley Alluvium- Natural Levees, and Southern Mississippi Valley Alluvium- Backswamps.

Basic definitions of the following soil classifications terms are included to describe the various classes discussed in the following section. Loamy soil refers to soils of intermediate texture between sandy and clayey soils. Clayey soils are made up of forty percent or more of clay, the smallest soil particle. Shaley soils include sedimentary rock

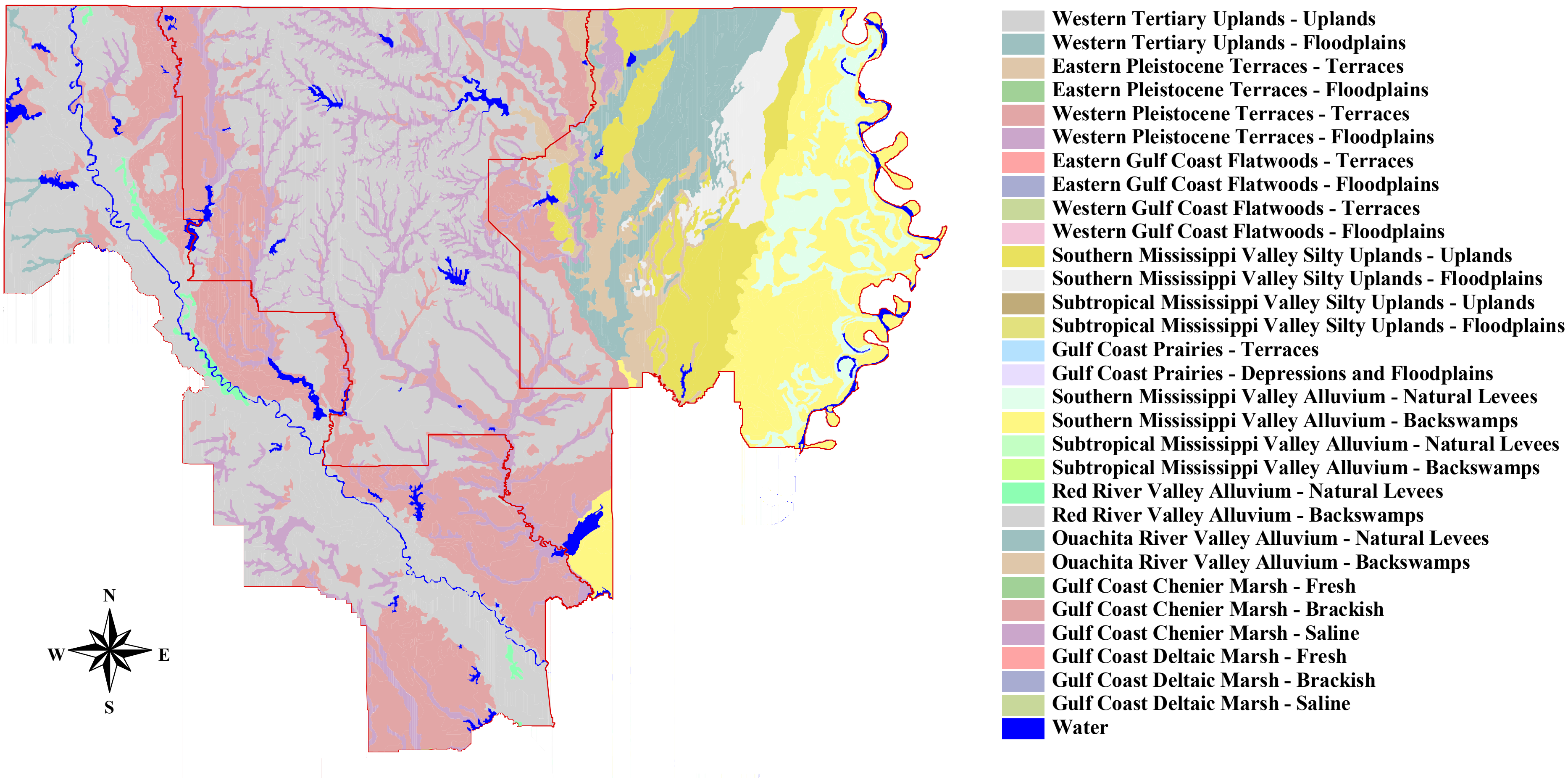

Figure 3.1. Northern Louisiana Soil Classification Map

derived from mud made up of clay minerals and rock minerals. Alluvium refers to deposits of sand, mud and other deposits on land by streams. Terraces refer to flat and usually narrow plains that border rivers and lakes. Loess refers to deposits of uniform silty material transported by wind during dry periods (USDA 1957).

Western Tertiary Uplands- Uplands soils represent soil that has loamy, clayey and shaley marine deposits. Western Tertiary Uplands- Floodplains represent soil that consists of sandy and loamy alluvial low terraces and floodplains. Eastern and Western Pleistocene Terraces- Terraces represent those soils that consist of loamy fluvial deposits. Western Pleistocene Terraces- Floodplains represent those soils that consist of loamy and sandy alluvial low terraces and floodplains. Southern Mississippi Valley Silty Uplands- Uplands represent those soils that are characterized by thick loess deposits. Southern Mississippi Valley Silty Uplands- Floodplains represent those soils that are characterized by mixed loess and loamy low terraces and floodplains. Southern Mississippi Valley and Red River Valley Alluvium- Natural Levees are soils that are characterized by loamy and clayey alluvial natural levees and low terraces. Southern Mississippi Valley Alluvium-Backswamps are those soils that are characterized by loamy and clayey low terraces and floodplains.

The Data

Data for this study were reported using mail survey techniques. The Louisiana Rural Land Market Survey is sent to a statewide listing of knowledgeable individuals of rural land markets. The survey has been conducted annually since 1994. The 2002 survey, for example, included over 1,000 individuals who were state certified appraisers, officers in commercial banks, personnel of the Farm Service Agency, Federal Land Bank and Production Credit Association, and members of the Louisiana Chapter of the American Society of Farm Managers and Rural Appraisers, and the Louisiana Realtors Land Institute.

The survey was constructed to facilitate the reporting of detailed information on actual sales of rural real estate in Louisiana and to record subjective information based on the respondent's knowledge of the local land market. For the purposes of the survey, rural real estate was defined as all land outside the city limits of the major metropolitan areas in Louisiana, 10 acres or more in size, and included attachments to the surface, such as buildings and other improvements.

Statewide, 3,806 sales have been reported during the January 1, 1993 to June 30, 2002 period. The data were spatially plotted based on the legal description of each tract using the GIS software package ARC/View.

The data for this study, a subset of the statewide data set, has 1,090 observations that were reported from actual sales transactions that occurred from January 1, 1993 through June 30, 2002 in the three selected submarkets being studied. Figure 3.2 shows the rural land sale observations in northern Louisiana. All sale prices are given in nominal terms. The data are both cross-sectional and time series data.

The Variables

Sale price per acre is the dependent variable of this study. Table 3.1 and 3.2 list the variables considered in the hedonic model analysis. The tables include both continuous and discrete variables. Continuous variables are quantitative in nature while discrete variables are qualitative, representing the presence or absence of a condition or characteristic. Each variable is discussed below.

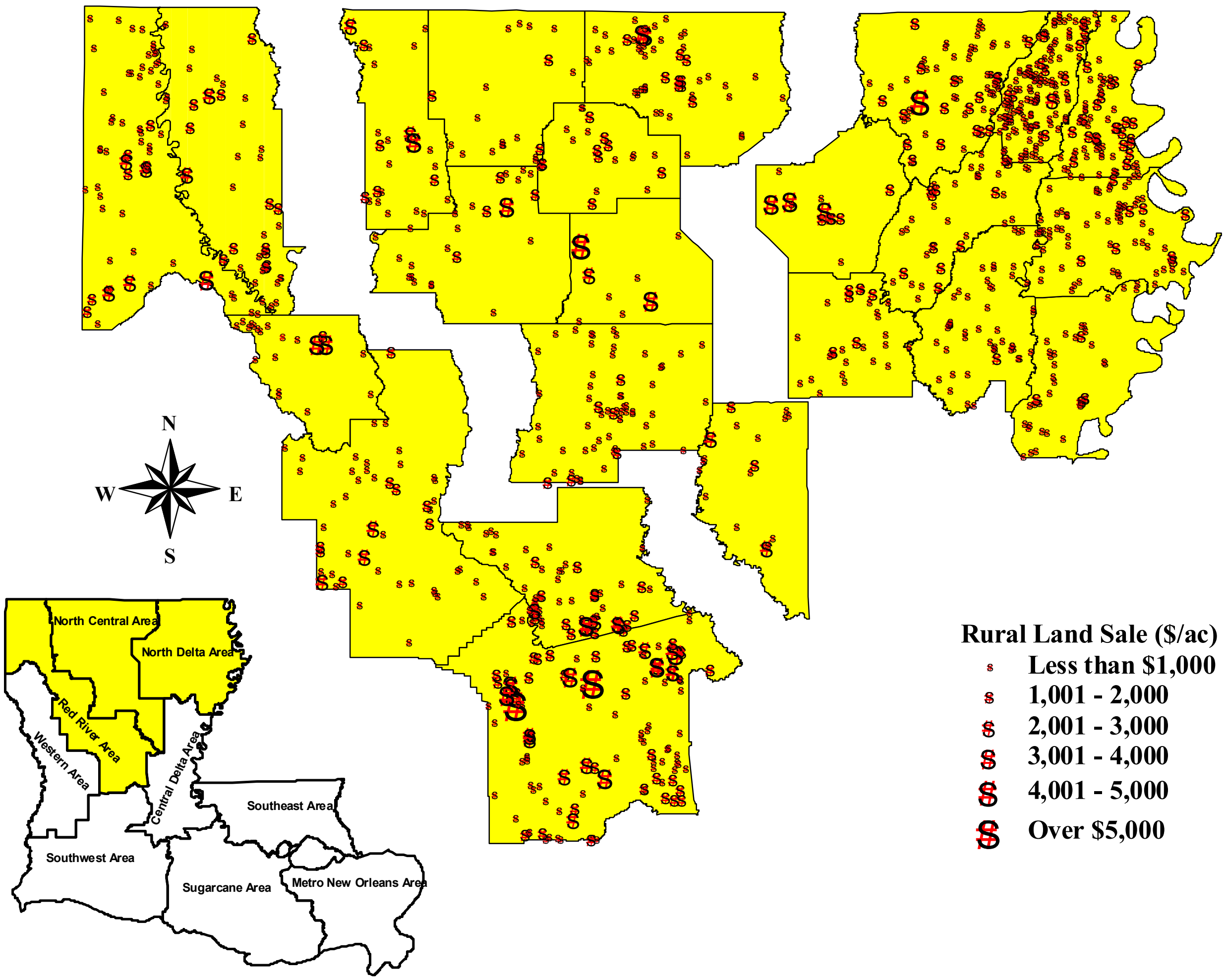

Figure 3.2. Northern Louisiana Rural Land Sale Observations

Continuous Variables

Continuous variables are those variables that have a quantitative magnitude associated with them. The greater the magnitude typically the greater the impending effect of that variable on the dependant variable being determined. There are several continuous variables evaluated in this study which will be explained in the pursuing discussion.

Survey Data Variables

Tract size (LNACRES) is expected to have the largest significant effect in the models. Because larger tracts have a higher overall total value and a smaller number of potential buyers, the effect of tract size is expected to be negative, reflecting an inverse relationship. Previous research suggests that this effect is nonlinear. The percentage of land in a tract devoted to row crops (PERCROP) is expected to have a positive influence on the dependent variable. Cultivated land may be priced at a premium because it represents an intensive use that is expected to generate an income stream in the future. Because pastureland also represents an intensive use of land, percent of pastureland (PERPAST) in the tract may also add to the value of rural land, depending on the extent of the improvements.

The presence of timberland (PERTIMB) in this model is also expected to have a positive influence on per acre price similar to that of row crops. One would expect that the presence of a stand of trees available for harvest increases the value of the land by the worth of the trees.

Percentage of cropland devoted to the primary crop (PRIACRES) is also expected to have a positive relationship to price per acre. Logically, farmers will plant the most

Table 3.1. Continuous Hedonic Pricing Model Variables, North Central, North Delta and Red River Submarkets, Louisiana.

Symbol Continuous Variables	Variable	Expected Sign
LNPRICE	Natural log of per acre sale price of land	
LNACRES	Natural log of size of tract in acres	(-)
PERCROP	Percentage of cropland in tract	(+)
PERPAST	Percentage of pastureland in tract	(+)
PERTIMB	Percentage of timberland in tract	(+)
PRIACRES	Number of acres used in production of primary crop	(+)
VALHOUSE	Value of house	(+)
IMPRSUM	Value of house, barn and improvements	(+)
ROADFEET	Road frontage in feet	(+)
TRMSACTY	Travel time in hours to nearest MSA city	(-)
TRTOWN	Travel time in hours to Parish seat	(-)
TIME	Measured by month, beginning Jan. 1993	(+)
POP2000	Parish Population in the year 2000	(+)
PCI1999	Per Capita Income for 1999	(+)
PERBP1999	% of Persons Below Poverty Level, 1999	(+/-)

Table 3.2. Discrete Hedonic Pricing Model Variables, North Central, North Delta and Red River Submarkets, Louisiana.

Symbol	Variable	Expected Sign
Discrete Variables		
SOIL1	Western Tertiary Uplands - Uplands	(+)
SOIL5	Western Pleistocene Terraces - Terraces	(+)
COTTBASE	Sale include cotton base acreage	(+)
CORNBASE	Sale include corn base acreage	(+)
MILOBASE	Sale include milo base acreage	(+)
OATBASE	Sale include oat base acreage	(+)
RICEBASE	Sale include rice base acreage	(+)
WHEATBASE	Sale include wheat base acreage	(+)
RT	Paved Road Access	(+)
RPEXPN	Reason for Purchase: Expansion	(+)
RPRESI	Reason for Purchase: Residence	(+)
RPINVEST	Reason for Purchase: Investment	(+)
RPCOMM	Reason for Purchase: Commercial	(+)
RPRECR	Reason for purchase: Recreation	(+/-)
INFLRESI	Influence on land value: Residence	(+)
INFLRECR	Influence on land value: Recreational	(+)
INFLCOMM	Influence on land value: Commercial	(+)
INFLFLOOD	Influence on land value: Flooding	(-)
INFLURBAN	Influence on land value: Urban Fringe	(+)
INFLHWY	Influence on land value: Highway	(+)
INFLPOND	Influence on land value: Pond	(+)
SHRBOSMSA	Sale located within the Shreveport-Bossier MSA	(+)
MONROEMSA	Sale located within the Monroe MSA	(+)
ALEXMSA	Sale located within the Alexandria MSA	(+)

profitable crop on the best suited soils. The more land devoted to a primary crop, the higher the expected future income stream.

The sum of the value of the existing house, any barn on the land, and improvements (IMPRSUM) made to or on the land (such as growing crops) is expected to have a direct relationship to the price per acre of land. Individually, each of the capital improvements including home (VALHOUSE), barn (VALBARN) and other improvements (VALIMPRV) are expected to have a positive effect on the value of land. Planted cropland is expected to have a positive relationship because of the income it is expected to produce; the house and other buildings and improvements because of the capital investment they add to the land.

Road frontage (ROADFEET) is also expected to have a direct relationship to the price per acre of land. Road frontage is measured in number of feet that border a road, and represents ease of access and enhances development potential for the future. Time (TIME) as measured by month, beginning with January 1993, is expected to have a positive impact on land price during the study period, due to the impact of appreciation of land value over time.

GIS Analysis Variables

As part of a complete understanding of the impacts that effect rural land values, it is necessary to consider the impact that major market centers and areas of economic development have in regard to rural land values. This hypothesized relationship can be measured in a variety of ways including both time and distance from major cities and other more populous regions near rural land. In this study, measurements were made in both time and distance to both Metropolitan Statistical Areas and to parish seats. Travel time was measured in hours to the nearest MSA city (TRMSACTY) and to the nearest parish seat (TRTOWN). Distance measured in miles was measured to the nearest MSA city (TDMSACTY) and to the nearest parish seat (TDTOWN). According to location theory, a negative relationship is expected to exist between rural land location and distance or time to nearest metropolitan areas; this infers that as distance or time increases from a rural land tract to a metropolitan area the lower the land value.

For the purposes of this study, three MSAs were considered including Monroe, Shreveport, and Alexandria (Figure 1.13). The parish seats of each parish within the submarkets were also used to measure the effect of a nearby town. Distance and time measurements were ascertained from each MSA and from each parish seat based on the location of the rural land tract.

Socioeconomic Variables

Socioeconomic variables in this study describe selected characteristics of the population. These variables do not have a direct effect on land or land values. However, population in an area can have an effect on demand in a region. For example, it is expected that as the population in a region increases, demand for land increases, which can positively affect land values. Income is expected to have a similar effect. Because these variables have the potential to effect land markets, they are included in this study.

Socioeconomic variables include those variables that are descriptive of the people that live in the rural areas and make purchasing decisions. These variables include parish population (POP2000) which is the population as of the 2000 U.S. Census. Per capita income (PCI1999) is measured as the average per capita income for each parish as of 1999. Additionally a variable measuring the poverty level was also included; this variable measures the percentage of persons below the poverty level as of 1999 (PERBP1999). Information for each of the submarkets is presented in Table 3.3 Generally it is expected that these socioeconomic variables should have a positive influence on land values. However, the expected effect of poverty level and its influence on rural land values is unclear as to whether it is positive or negative.

Table 3.3. Summary Statistics of Socioeconomic Variables for Louisiana

	Per Capita Income	% of persons Below Poverty Level	Population 1990	Population 2000	Population % Change
Red River	15,386	22.20%	268,323	273,156	1.80%
North Central	13,977	22.20%	529,496	544,208	2.78%
North Delta	12,665	29.10%	183,444	186,319	1.57%
Louisiana	16,912	19.60%	4,219,973	4,468,976	5.90%
United States	21,587	12.40%	248,709,873	281,421,906	13.15%

source: US Census

Discrete Variables

Discrete variables are sometimes known as dummy variables and are either present or absent from the data. A description of these variables follows. Generally speaking, the presence of these variables has a positive impact on land values; however, there are some exceptions that will be discussed further.

Survey Data Variables

The discrete survey data variables are all expected to have a positive effect on the value of rural land with the exception of influence of flooding. There are two major categories of discrete variables: 1) variables that influence the value of land and 2) variables that describe reasons for purchase. Other discrete variables not included in these two categories include paved road access, soil classification and participation in base acreage programs. Paved access road (RT) represents ease of access to a property and enhances the development potential for future expansion similar to that of road frontage. Soil classification (SOIL1, SOIL5) is represented by soil type and is usually dependent on location. Two such soil types are the Western Tertiary Uplands-Uplands (SOIL1) and the Western Pleistocene Terraces-Terraces (SOIL5). Depending on the classification of soil, there are different crops that can be grown which can affect land value.

Accordingly, a positive impact on land values should also be associated with acreage that is included in a government base program. Government programs offer a potential for increased income in two ways based on whether the land itself is enrolled in a government program and based on the underlying current crop grown on the land. For this study, base programs considered include those for corn (CORNBASE), cotton (COTTONBASE), milo (MILOBASE), oats (OATBASE), rice (RICEBASE), and wheat (WHEATBASE).

Within the data set there are two categories of variables that evaluate the reason that land is purchased and another variable that evaluates particular influences a characteristic may have on land value. Reason for purchase variables include: Expansion, Residence, Recreation, Investment, Commercial Development and Establish Farm. Expansion (RPEXPN), recreation (RPRECR), establish farm (RPFARM), and investment (RPINVEST) as the primary reasons for purchase are expected to have income generating benefits and/or increase the demand for land and positively affect land values. Expansion can include the addition of some capital structure or can include the addition of land to an existing property. Recreation as the primary reason for purchase implies a use for the land that may or may not provide income streams. However, the land may be more valuable to the purchaser based on the type of recreation it provides, which is expected to positively affect land values. The establishment of a farm implies a direct and intensive use of land, which is expected to provide future income and thus have a positive impact on land values. Investment as the reason for purchase implies that there may be some ability for the purchaser to receive income from the land acquisition which could include lease payments. Residence (RPRESI) and commercial development (RPCOMM) as the primary reasons for purchase are also expected to have a positive effect, because the purchase of a residence or business is both a consumptive and investment action. Reason for purchase as residence specifically reflects the desire for the land purchased to be used for the purpose of establishing a dwelling. Commercial development as the reason for purchase would indicate that the land may have some higher value based on the ability for it to be developed for commercial purposes which have the potential to increase income opportunities.

Variables identified as having a significant influence on land value include: commercial, residential, pond, flooding, recreational, urban fringe, and highway. Commercial (INFLCOMM), residential (INFLRESI), and recreational (INFLRECR) are expected to have a positive impact on land values similar to that of the reason for purchase variables. Influence of highway (INFLHWY) implies that the land is easily accessed by a major highway. This is expected to have a positive impact on land values because of ease of access for transportation. Influence of urban fringe (INFLURBAN) is expected to have a positive affect on land values, as it is expected that land encroaching on major cities tends to have a greater value. It is hypothesized that the influence of flooding (INFLFLOOD) is expected to have a negative impact on land value. This hypothesis is reasonable given that land that is prone to flooding prohibits many other influences from having a positive effect. Another influence variable studied is the influence of pond variable (INFLPOND), which is expected to have a positive impact on land values based on the positive attributes that it provides whether for irrigation or for recreation.

GIS Analysis Variables

Within the three submarkets being evaluated there exist three metropolitan areas. These are Monroe (MONROEMSA), Shreveport (SHRBOSMSA), and Alexandria (ALEXMSA). The influence these metropolitan areas have on rural land near the metropolitan urban fringe is expected to effect land values. There is a hypothesized positive impact on land values for sales located within the metropolitan statistical area of these cities.

CHAPTER 4

EMPIRICAL RESULTS

The purpose of this study is to estimate the impact that the variables discussed in the preceding pages have on rural land values in northern Louisiana. This section of the study will detail the results obtained once the modeling was completed. A model was estimated for each submarket and all resulting information will be broken out by submarket. All data analysis resulting in determining the significance of variables within each model was completed in SAS. Marginal implicit prices were calculated to determine the effect that individual land characteristics have on land values.

Descriptive Results

This section summarizes the descriptive statistics relating to price and size of tract for each of the three submarkets studied. These statistics are reported in Table 4.1.

The Red River submarket is made up of six parishes including: Bossier, Caddo, Natchitoches, Grant, Rapides, and Red River. Metropolitan statistical areas within this submarket include both Shreveport and Alexandria. The minimum and maximum price per acre of land is $87 and $9,351 respectively, with a mean of $1,025.40. The standard deviation is 911.12, indicating large variability in prices per acre. Tract size ranged from 10 to 5,400 acres, with a mean of 72 acres and a standard deviation of 409.41.

The North Central Submarket includes eight parishes: Bienville, Claiborne, Jackson, La Salle, Lincoln, Union, Webster, and Winn. There are no metropolitan statistical areas within this submarket. The minimum and maximum price per acre of land is $50 and $15,000 respectively, with a mean of $933.67. The standard deviation is

Table 4.1. Descriptive Land Characteristics, North Louisiana Submarkets, Rural Land Survey, January 1, 1993 to June 30, 2002

Land Characteristics	Number of Reported Sales	Minimum	Maximum	Median	Mean	Standard Deviation	Coefficient of Variation
Red River Submarket	342						
Price per Acre ($)		87	9,351	750	1,025.40	911.12	88.86%
Size (acres)		10	5,400	72	195.67	409.41	209.24%
North Central Submarket	229						
Price per Acre ($)		50	15,000	658	933.67	1,293.11	138.50%
Size (acres)		10	842	60	92.97	111.84	120.30%
North Delta Submarket	519						
Price per Acre ($)		186	5,000	700	781.25	418.95	53.63%
Size (acres)		10	4,758	120	275.64	429.49	155.82%

1,293.11, indicating extremely large variability in prices. Tract size ranged from 10 to 842 acres, with a mean of 92.97 acres and a standard deviation of 111.84.

The North Delta submarket has nine parishes: Caldwell, East Carroll, Franklin, Madison, Morehouse, Ouachita, Richland, Tensas, and West Carroll. Monroe, within Ouachita Parish, is the only metropolitan statistical area within this submarket. The minimum and maximum price per acre of land is $186 and $5,000 respectively, with a mean of $781.25. The standard deviation is 418.95, indicating some variability in prices. Tract size ranged from 10 to 4,758 acres with a mean of 275.64 acres and a standard deviation of 429.49.

Interpretation of Model Coefficients

Three models were run, one for each of the submarkets studied. Table 4.2 details the results, listing all the model coefficients and standard errors by submarket. All variables were significant at the .01, .05, .10, or .15 level of significance.

<u>Red River Submarket</u>

All model coefficients of variables that make up the Red River submarket had appropriate signs and were significant. The only model coefficient that had an unexpected sign was for the reason for purchase for recreation variable (RPRECR). The negative sign associated with the model coefficient indicates that there are no premiums placed on land purchased for recreational purposes. The reason for this may be because this land has no other higher and better use and may be marginal land lending itself to be used for recreational pursuits. The negative sign on the size of tract (LNACRES) indicates, as expected, that as size of tract increases price per acre decreases. Percentage of land in crop (PERCROP) and pasture (PERPAST) were both significant and positive,

Table 4.2 Estimated Hedonic Model, North Louisiana Submarkets, Rural Land Survey , January 1, 1993 to June 30, 2002

	Red River		North Central		North Delta	
Variables	Model Coefficient	Standard Error	Model Coefficient	Standard Error	Model Coefficient	Standard Error
Intercept	7.27*	0.14111	5.92*	0.41956	5.25*	0.34597
LNACRES	-0.24*	0.02596	-.24*	0.03873	-.035**	0.01637
PERCROP	0.003*	0.00094			.002*	0.00040
PERPAST	0.002**	0.00087	.007*	0.00117		
PERTIMB			.003*	0.00099		
VALHOUSE			.000008***	0.000005		
IMPRSUM	0.000009*	0.0000001				
TRMSACTY	-0.44*	0.09521				
TRTOWN			-.29***	0.16326		
TIME	0.008*	0.00074	.009*	0.00119	.005*	0.00050
POP2000					.000005*	0.0000010
PCI1999			.00008*	0.00003	.00004**	0.0000216
PERBP1999					.017*	0.00413
SOIL1	0.16**	0.08097				
SOIL5	0.22*	0.07046				
COTTBASE					.0005*	0.00012
RT	0.29*	0.05653				
RPRECR	-0.33*	0.11788	-.24***	0.13779	-.14****	0.09315
INFLCOMM	0.56**	0.28154	.66*	0.19591	1.10*	0.20016
INFLFLOOD	-0.37*	0.08484	-.31**	0.13942		
INFLURBAN	0.51*	0.11611				
INFLHWY	0.25***	0.14588	.34****	0.21313		
INFLPOND					.64*	0.24522
R-square	0.5914		0.4552		0.3404	

*denotes significance at the 0.01 level, **denotes significance at the 0.05 level, ***denotes significance at the 0.10 level, ****denotes significance at the 0.15 level as expected, implying an intensive use of land. The total value of improvements (IMPRSUM) was also positive and significant, indicating that the value of improvements such as barns and houses has a positive effect on land values. Also of significance was the distance variable that measured distance, in time, to the nearest metropolitan statistical area (TRMSACTY). This variable was negative, indicating that as the distance in time from a metropolitan statistical area increases, there is a negative effect on land value. All other influence and reason for purchase variables were significant and had expected signs, including: commercial (INFLCOMM), flooding (INFLFLOOD), urban (INFLURBAN), and highway (INFLHWY). Two soil variables (SOIL1, SOIL5) were also significant, indicating that soils with high productivity characteristics have the ability to positively affect land values.

North Central Submarket

The North Central submarket model was made up of several highly significant variables. All variables had expected signs with the exception of the reason for purchase for recreation variable (RPRECR) which had a negative sign, just as the Red River submarket did. The negative sign was expected for the size of tract (LNACRES) and for the influence of flooding variable (INFLFLOOD). A negative sign was also expected for the distance variable that measured distance, in time, to the nearest parish seat (TRTOWN) indicating that the amount of time it took to reach the parish seat effected land value. As the time to reach the town increased land value decreased. Both percentage of land in timber (PERTIMB) and pasture (PERPAST) had positive coefficients, as expected, representing as intensive use of land. The value of housing (VALHOUSE) also had a positive significant effect on land values. Of further significance were the influence variables, commercial (INFLCOMM) and highway (INFLHWY), which both had expected positive effects on land value. Of the socioeconomic variables that were included in the study, the per capita income variable (PCI1999) was significant and positive indicating that the income level has a direct effect on land value in this submarket.

North Delta Submarket

The North Delta submarket had the least number of significant variables and the most socioeconomic variables that were significant. Again, with the exception of the reason for purchase variable for recreation (RPRECR) having an unexpected negative sign, all other variables had expected signs. The size of tract (LNACRES) was significant and negative as expected. Percentage of land in crops (PERCROP) was positive and highly significant, as was the cotton base variable (COTTBASE). This is reasonable given the dependence of this submarket on row crop agriculture. Also having a positive significant impact on land values were the influence variables, commercial (INFLCOMM) and pond (INFLPOND). All of the socioeconomic variables that were used in this study were found to be significant and positive. These variables included the 2000 population (POP2000), 1999 per capita income (PCI1999), and 1999 percentage below the poverty level (PERBP1999). This indicates that the socioeconomic conditions of the submarket have a direct impact on land values.

Marginal Implicit Prices of Characteristics

The last part of the hedonic modeling process involves calculating the marginal implicit prices, which are evaluated at the mean values of per acre price and of the characteristics. The calculations are needed to evaluate the magnitude of the effect a given characteristic has on land values. A positive marginal implicit price indicates that an increase in that characteristic has a positive effect on land values, holding all other variables constant. A negative marginal implicit price indicates a decreasing effect on land values, holding all other variables constant.

Red River Submarket

Marginal implicit prices estimated for the Red River submarket are presented in Table 4.3. Marginal implicit prices were calculated based on the hedonic model estimates that were previously discussed. All calculations were based on the model coefficients and mean price ($1,025.40) or mean characteristic level for size of tract (195.67) as applicable.

As expected, the marginal implicit price of size of tract (LNACRES) indicated that as the size of tract increased per acre, the price per acre decreased by $1.24. Both percentage of land in crops (PERCROP) and percentage of land in pasture (PERPAST) have positive effects on land values. As the percentage of land in crops increased by one percent, the price per acre increased by $3.57. Similarly, as the percentage of land in pasture increased by one percent, the price per acre increased by $1.98. If a tract of land was one hundred percent in crops or pasture, its value per acre would be $357.00 or $198.00 more per acre, respectively. The marginal implicit price for total value of improvements (IMPRSUM) suggests that for every $10,000 worth of improvements, the price per acre for a tract of land is $100.00 more than for acreage with no improvements. The marginal implicit price for the variable TRMSACTY, which measured distance in time to the nearest MSA city, indicated that for every hour increase in the distance from this city there was a decrease in rural land value of $453.30 per acre. The marginal

Table 4.3 Estimated Hedonic Model and Marginal Implicit Prices, North Louisiana Submarkets, Rural Land Survey, January 1, 1993 to June 30, 2002

	Red River		North Central		North Delta	
Variables	Model Coefficient	Marginal Implicit Price	Model Coefficient	Marginal Implicit Price	Model Coefficient	Marginal Implicit Price
Intercept	7.27*		5.92*		5.25*	
LNACRES	-0.24*	-$1.24	-.24*	-$2.24	-.035**	-$0.10
PERCROP	.003*	$3.57			.002*	$1.27
PERPAST	.002**	$1.98	.007*	$5.91		
PERTIMB			.003*	$2.49		
VALHOUSE			.000008***	$0.01		
IMPRSUM	.000009*	$0.01				
TRMSACTY	-0.44*	-$453.30				
TRTOWN			-.29***	-$250.94		
TIME	.008*	$7.69	.009*	$8.10	.005*	$3.62
POP2000					.000005*	$0.004
PCI1999			.00008*	$0.07	.00004**	$0.03
PERBP1999					.017*	$13.63
SOIL1	.16**	$176.65				
SOIL5	.22*	$248.62				
COTTBASE					.0005*	$0.41
RT	.29*	$343.95				
RPRECR	-.33*	-$296.07	-.24***	-$192.01	-.14****	-$107.98
INFLCOMM	.56**	$705.86	.66*	$782.98	1.10*	$1,516.61
INFLFLOOD	-.37*	-$317.33	-.31**	-$241.47		
INFLURBAN	.51*	$668.72				
INFLHWY	.25***	$271.70	.34****	$330.15		
INFLPOND					.64*	$655.33

*denotes significance at the 0.01 level, **denotes significance at the 0.05 level, ***denotes significance at the 0.10 level, ****denotes significance at the 0.15 level implicit value of the variable month of sale (TIME) suggests that a one month increase in the time of sale will increase per acre land value by $7.69.

Western Tertiary Uplands- Uplands soil (SOIL1) and Western Pleistoncene Terraces- Floodplains (SOIL5) had marginal implicit prices of $176.65 and $248.62 respectively, indicating that tracts of land in these soil types would be valued higher per acre than tracts in other soil types. The marginal implicit price of paved road access (RT) was $343.95, indicating a higher price per acre than if there were no paved access. The estimated implicit price for commercial influence (INFLCOMM) suggests that rural land can be sold for just over $700 per acre more when there is potential for commercial development. In similar fashion, as rural land fringes upon urban areas the price per acre is expected to be on average over $650 more per acre than for land that is not near urban areas. As well, the influence of highway (INFLHWY) is expected to increase the value of rural land over $270 per acre when there is potential for the development of a highway. The marginal implicit price of the reason for purchase for recreation variable (RPRECR) suggests that land bought for recreational pursuits are valued at almost $300 per acre less than land bought for other purposes. Land that has the influence of flooding (INFLFLOOD) has a marginal implicit price of -$317.33, indicating that per acre value of land that floods is much less than land that does not flood.

North Central Submarket

Marginal implicit prices were estimated for the North Central submarket are presented in Table 4.3. Marginal implicit prices were calculated based on the hedonic model estimates that were previously discussed. All calculations were based on the model coefficients and mean price ($871.97) or mean characteristic level for size of tract (93.30), as applicable.

Again, the marginal implicit price of size of tract (LNACRES) indicated that as the size of tract increased per acre, the price per acre decreased by $2.24. Both percentage of land in timber (PERTIMB) and percentage of land in pasture (PERPAST) have positive effects on land values. As the percentage of land in pasture increased by one percent, the price per acre increase by $5.91. Similarly, as the percentage of land in timber increased by one percent, the price per acre increased by $2.49. If a tract of land were one hundred percent in pasture or timber, its value per acre would be $591.00 or $249.00 more per acre, respectively. The marginal implicit price for total value of housing (VALHOUSE) suggests that for every $10,000 worth of housing, the price per acre for a tract of land is $100.00 more than for acreage with no housing. The marginal implicit price for the variable, TRTOWN, which measured distance in time to the nearest town (parish seat), indicated that for every hour increase in the distance from town there was a decrease in rural land value of $250.94 per acre. The marginal implicit value of the variable month of sale (TIME) suggests that a one month increase in the time of sale will increase per acre land value by $8.10. The impact of per capita income (PCI1999) suggests that as per capita income increases by $1,000, rural land values increase by $70 per acre.

Of the influence variables, commercial influence (INFLCOMM) has a marginal implicit price of $782.98 and highway influence has a marginal implicit price of $330.15, indicating that the presence of these factors has the potential to greatly increase rural land values. The marginal implicit price of the reason for purchase for recreation variable

(RPRECR) suggests that land bought for recreational pursuits are valued at almost $200 per acre less than land bought for other purposes. Land that has the influence of flooding (INFLFLOOD) has a marginal implicit price of -$241.47, indicating that per acre value of land that floods is much less than land that does not flood.

North Delta Submarket

Marginal implicit prices estimated for the North Delta submarket are presented in Table 4.3. Marginal implicit prices were calculated based on the hedonic model estimates that were previously discussed. All calculations were based on the model coefficients and mean price ($781.25) or mean characteristic level for size of tract (275.64), as applicable.

The marginal implicit price of size of tract (LNACRES) indicated that as the size of tract increased per acre, the price per acre decreased by $.10. Percentage of land in crops (PERCROP) was found to be significant, and the marginal implicit price indicated that as the percentage of land in crops increased by one percent the per acre value of land increased by $1.27. The marginal implicit value of the variable month of sale (TIME) suggests that a one month increase in the time of sale will increase per acre land value by $3.62. All of the socioeconomic variables that were studied were found to be of significance in the North Delta submarket. The marginal implicit price of population (POP2000) indicates that as population increases by 1,000, the price per acre of rural land increases by $4.14. The impact of per capita income (PCI1999) suggests that as per capita income increases by $1,000, rural land values increase by $34.83 per acre. Lastly, the variable measuring the percent of population below the poverty level was significant, and its marginal implicit price suggests that a one percent change in poverty level brings about a change of $13.63 in the price per acre of rural land.

Rural land values in this submarket were also affected by participation in the government cotton base program (COTTBASE). The marginal implicit price suggests that land in the cotton base program would be valued at $.41 more per acre than land that is not enrolled in the cotton base program. As in the other two submarkets, the reason for purchase for recreation variable (RPRECR) had a marginal implicit price that indicated that land bought for recreational pursuits are valued at over $100 per acre less than land bought for other purposes. Of the influence variables, commercial influence (INFLCOMM) had a marginal implicit price of $1,516.61, implying that land that has the potential to be purchased for commercial pursuits is valued more than land that has no commercial implications. The influence of pond variable (INFLPOND) had a marginal implicit price of $655.33, indicating that the presence of a pond has the potential to increase rural land values. The presence of a pond could serve many purposes, including serving as a source of recreation or more importantly possibly as a source of irrigation, which would explain its significance in this submarket.

Summary

Hedonic models were used to estimate the effects of rural land characteristics and socioeconomic characteristics on the value of rural land. Many of the influence and reason for purchase variables were found to be significant as were the socioeconomic variables. Several other land characteristic variables were found to be significant.

Size of tract (LNSIZE) had a negative effect on rural land values as expected. Time, on the other hand, had a positive effect on land values in all three submarkets.

Commercial influence and reason for purchase for recreation were the only other two variables that affected all three submarkets. Commercial influence had a positive effect on land values and reason for purchase for recreation had a negative effect on land values.

The distance variables that were found to be significant both measured distance in time and were significant in the Red River and North Central submarket. The socioeconomic variables were found to be significant and to have a positive effect on land values in the North Central and North Delta submarket. Influence of highway and flooding had expected impacts and significantly affected the Red River and North Central submarkets. Urban influence was positive and significant in the Red River submarket. The influence of pond was positive and significant in the North Delta submarket.

Marginal implicit prices were calculated for all the significant variables. The variable with the greatest impact on per acre land prices was the commercial influence variable. Price ranged from $705.86 per acre more in the Red River submarket to $1,516.61 per acre more in the North Delta submarket. Each marginal implicit price is calculated from mean values and has the estimated effect on per acres rural land prices, holding all other variables constant.

CHAPTER 5

SUMMARY AND CONCLUSIONS

Summary

Northern Louisiana has historically relied heavily on agriculture to sustain local economies, and the agriculture present covers a wide array of endeavors. The majority of agricultural crops are comprised of timber, cotton, soybeans, corn, or cattle. Land in any particular submarket has a higher likelihood of being in one area of agricultural production or another. The uniqueness of Northern Louisiana in its topography and agriculture is what has driven the study of the three submarkets that make up this part of the state, which have previously not been specifically studied.

The purpose this research intended to fulfill was to identify and quantify those characteristics and influences that effect land values significantly in order to better understand land valuation. This research also determined that there are distinguishing differences among submarkets regarding attributes specific to land and other attributes, including socioeconomic factors. These purposes were achieved through the process of gathering information about land sales that have taken place in northern Louisiana. Specific characteristics and influences were identified that helped to further explain what comprised the final price of an acre of land. Once identified, the effects of these characteristics and influences were quantified to determine the marginal impact they had on land value. By developing a statistical model of agricultural land sales for the Red River, North Central, and North Delta submarkets of Louisiana, the objectives of this study were able to be met. Implicit marginal values for statistically significant characteristics in the model were calculated and discussed.

Marginal implicit prices were calculated for all significant variables for each of the three submarkets of this study. The marginal implicit prices represent the amount by which per acre rural land values change given a one unit change in the land characteristics or other explanatory variables. Table 4.3 summarizes all these results.

The marginal implicit price of the percentage of land in crops ranged from \$1.27 to \$3.57 per acre and was significant only in the Red River and North Delta submarket. The marginal implicit price for percentage of land in pasture ranged from \$1.98 in the Red River submarket to \$5.91 in the North Central submarket. Percentage of land in timber was only significant in the North Central submarket and suggested a change in per acre price of \$2.49 when timber was present. The value of a house affected the North Central submarket and suggested a per acre change in price of \$100 per acre for every \$10,000 worth of house. Similarly, the Red River submarket was impacted by total improvements including housing and barns. The per acre change in price resulting in the presence of improvements was \$100 per acre for every \$10,000 worth of improvements. Of the distance variables reviewed in the study, only the distance variables measuring distance in time were found to be significant. In the Red River submarket, the distance in time to the nearest metropolitan statistical area was significant and suggested that the further a tract of land was from the city the lower the value per acre. In the North Central submarket, the distance in time to the nearest parish seat was significant and suggested that the further the tract of land was from the nearest town the lower the value per acre.

The socioeconomic variables were significant in only two of the three submarkets. It is interesting to see how an indirect characteristic was able to significantly affect land values. In the North Central submarket, the per capita income variable was significant and suggested that the value of land per acre increased by $70 for every $1,000 increase in per capita income. In the North Delta submarket all three variables were significant. The population and per capita income variables suggested that as the population and per capita income rose, per acre value of rural land also rose. The variable that measured percentage below poverty level had a marginal implicit price that suggested that as the percentage below poverty level rose, rural land values increased. The reason for this is unclear. It could be that in poorer areas, rural land is worth more due to its high agricultural productivity. In any event, the fact that these variables were significant is important as it suggests that rural land values are influenced by socioeconomic characteristics.

Soil classification was important in the Red River submarket only. The presence of the Western Tertiary Uplands- Uplands soil (SOIL1) and Western Pleistocene Terraces- Terraces soil (SOIL5) suggested that rural land values increased over land that did not have these soil classifications. The government cotton base program was only significant in the North Delta submarket and had a small positive effect on rural land values. Having paved road access was significant in the Red River submarket and had a large positive effect on rural land values. In all three submarkets, the reason for purchase variable for recreation had a negative effect on land values. The greatest negative effect occurred in the Red River submarket and the least negative effect occurred in the North Delta submarket. The reason for this result could be that the purchase of land for recreational purposes suggests that there is no higher or better use for the land. In that case, the only use would be for recreational purposes.

Of the influence variables, commercial, flooding, urban, highway, and pond were found to be significant. Commercial influence was significant in all three submarkets and affected per acre prices in the range of \$705.86 to \$1,516.61 per acre. Flooding influence was significant in the Red River and North Central submarkets and ranged from a decrease of \$241.47 to \$317.33 per acre. Urban influence was significant in the Red River submarket and suggested that rural land values increased as urban areas encroached into rural areas. Highway influence was significant in the Red River and the North Central submarket and ranged in price from \$271.70 to \$330.15 per acre. The influence of pond was significant in the North Delta submarket only and suggested a premium per acre of \$655, mostly likely due to the need in this area for a source of irrigation for crops.

Conclusions

The natural resource endowment of each of the three submarkets in this study differs significantly from one another. Topography has clearly identifiable impacts on crop selection and income in each submarket. Additionally, the relative location of the submarkets to major metropolitan areas is influential on rural land value in each submarket. As a result, the factors that contribute most to the value of rural land in each submarket also differ. This study successfully demonstrates that these differences are statistically significant in explaining the value of rural land.

The Red River submarket is anchored geographically by MSAs at the north and south ends of the submarket. Agriculture in the submarket is a blend of timber, row crops, and cattle. The resulting model identified travel time to the MSAs as a major contributor to land value. Commercial and urban development were identified as principal influences. Coinciding with this influence of cities was the presence of paved roads. Soils and percentage of crop and pasture were also significant factors in explaining rural land value.

The North Central submarket is dominated by timber production. The resulting model found the percentage of timber a significant explanatory variable.

The North Delta submarket, on the other hand, is primarily row crop agriculture. The percentage of cropland is a significant explanatory variable in this model, as well as cotton base. This submarket is also more influenced by socioeconomic variables, as all three variables in the study are statistically significant.

Further Research and Limitations

This study showed that land can be valued based on the characteristics and attributes of the land. It is also valued based on factors that indirectly affect it, as shown in the significance of the socioeconomic variables. Could it be argued that regardless of the characteristics of land, there is a point reached in which land is not valued based on its attributes, but on the economic and socioeconomic conditions that surround that land? It would be necessary to do further research on how socioeconomic characteristics affect land values to fully answer that question. One implication that can be drawn from this thought process is the possibility that land that is extremely valuable based on its physical characteristics would be less valuable due to its surrounding economy.

One limitation of this research is that all the figures are based on data that was available from the survey completed by respondents and does not include complete and exhausted information on all rural land sales the three submarkets studied. Therefore, the estimates calculated should be used as a basis for additional information regarding land being valued and not as the sole source of information. Individual sales in local markets have the ability to vary greatly depending on market supply and demand factors at the time of sale.

REFERENCES

Chicione, D. L. "Farmland Values at the Urban Fringe: An Analysis of Sale Prices." *Land Economics*. 57 (August 1981): 353-62.

Downing, P. B. " Factors Affecting Commercial Land Values: An Empirical Study of Milwaukee, Wisconsin." *Land Economics*. 49 (Feb. 1973): 44-56.

Elad, R. L., I. D. Clifton, and J. E. Epperson. "Hedonic Estimation applied to the Farmland Market in Georgia." *Journal of Agricultural and Applied Economics*. 26:2(December 1994):351-66.

Frank, D. and S. Crawford. *2002 Louisiana Agricultural Statistics*. Louisiana Agricultural Statistics Service, USDA. AEA Information Series No.213, Oct. 2003.

Freeman, A. M., III. "Hedonic Prices, Property Values and Measuring Environmental Benefits: A Survey of the Issues." *Scandinavian Journal of Economics*. 81(1979):154-173.

Kennedy, G. A. *A Spatial Analysis of Variation in Rural Real Estate Prices Across Homogeneous Land Market Areas in Louisiana*. Unpublished Ph.D. Dissertation, Louisiana State University, 1995.

Kennedy, P. E. "Estimation with Correctly Interpreted Dummy Variables in Semilogarithmic Equations." *American Economic Review*. 71(1981):801.

Louisiana State University. *Louisiana Summary Agricultural and Natural Resources 2003.* Louisiana State University Agricultural Center, March 2004.

Miranowski, J. A. and B. D. Hammes. "Implicit Prices of Soil Characteristics for Farmland in Iowa." *American Journal of Agricultural Economics*. 66 (1984): 745-49.

Palmquist, R. B. "Land as a Differentiated Factor of Production: A Hedonic Model and Its Implication fro Welfare Measurement." *Land Economics*. 65:1(Feb. 1989): 23-28.

Patterson, R. W. and K. Boyle. "Out of Sight, Out of Mind? Using GIS to Incorporate Visibility in Hedonic Property Value Models." *Land Economics*. 78: 3(Aug. 2002): 417-25.

Rosen, S., "Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition." *Journal of Political Economy*. 82(January 1974): 34-55.

Reynolds, J. and A. Regalado. "The Effects of Wetlands and Other Factors on Rural Land Values." *The Appraisal Journal*. April 2002: 182-190.

United States Department of Agriculture, *Soil, the 1957 Yearbook of Agriculture.* 85th Cong., 1st sess. H. Doc. 30. Washington: GPO, 1957.

U.S. Census Bureau. "State and County Quickfacts." http://quickfacts.census.gov/qfd/index.html. June 28, 2004

APPENDIX. SOIL CLASSIFICATION

Table A.1. Soil Classification Identification

Soil Catagories	Name	Description
1	Western Tertiary Uplands - Uplands	Loamy, Clayey and Shaley Marine Deposits
2	Western Tertiary Uplands - Floodplains	Sandy and Loamy Alluvial Low Terraces and Floodplains
3	Eastern Pleistocene Terraces - Terraces	Loamy Fluvial Deposits
4	Eastern Pleistocene Terraces - Floodplains	Loamy and Sandy Alluvial Low Terraces and Floodplains
5	Western Pleistocene Terraces - Terraces	Loamy Fluvial Deposits
6	Western Pleistocene Terraces - Floodplains	Loamy and Sandy Alluvial Low Terraces and Floodplains
7	Eastern Gulf Coast Flatwoods - Terraces	Loamy and Silty Deposits
8	Eastern Gulf Coast Flatwoods - Floodplains	Loamy and Silty Alluvial Low Terraces and Floodplains
9	Western Gulf Coast Flatwoods - Terraces	Loamy and Silty Deposits
10	Western Gulf Coast Flatwoods - Floodplains	Loamy and Silty Alluvial Low Terraces and Floodplains
11	Southern Mississippi Valley Silty Uplands - Uplands	Thick Loess Deposits
12	Southern Mississippi Valley Silty Uplands - Floodplains	Mixed Loess and Loamy Low Terraces and Floodplains
13	Subtropical Mississippi Valley Silty Uplands - Uplands	Thick Loess Deposits
14	Subtropical Mississippi Valley Silty Uplands - Floodplains	Mixed Loess and Loamy Low Terraces and Floodplains
15	Gulf Coast Prairies - Terraces	Clayey and Loamy Alluvial Deposits
16	Gulf Coast Prairies - Depressions and Floodplains	Loamy and Clayey Aluvial and Outwash Deposits
17	Southern Mississippi Valley Alluvium - Natural Levees	Loamy and Clayey Aluvial Natural Levees and Low Terraces
18	Southern Mississippi Valley Alluvium - Backswamps	Loamy and Clayey Low Terraces and Floodplains
19	Subtropical Mississippi Valley Alluvium - Natural Levees	Sandy and Loamy Alluvial Natural Levees and Low Terraces
20	Subtropical Mississippi Valley Alluvium - Backswamps	Loamy and Clayey Low Terraces and Floodplains
21	Red River Valley Alluvium - Natural Levees	Sandy and Loamy Alluvial Natural Levees and Low Terraces
22	Red River Valley Alluvium - Backswamps	Loamy and Clayey Low Terraces and Floodplains
23	Ouachita River Valley Alluvium - Natural Levees	Sandy and Loamy Alluvial Natural Levees and Low Terraces
24	Ouachita River Valley Alluvium - Backswamps	Loamy and Clayey Low Terraces and Floodplains
25	Gulf Coast Chenier Marsh - Fresh	Fresh Organic and Mineral Coastal Deposits
26	Gulf Coast Chenier Marsh - Brackish	Brackish Organic and Mineral Coastal Deposits
27	Gulf Coast Chenier Marsh - Saline	Saline Organic and Mineral Coastal Deposits
28	Gulf Coast Deltaic Marsh - Fresh	Fresh Organic and Mineral Deltaic Deposits
29	Gulf Coast Deltaic Marsh - Brackish	Brackish Organic and Mineral Deltaic Deposits
30	Gulf Coast Deltaic Marsh - Saline	Saline Organic and Mineral Deltaic Deposits
31	Water	Water

VITA

Rebecca Summers McLaren is a native of Rayville, Louisiana. In 1998, she received her Bachelor of Science degree in Agricultural Business at Louisiana State University. After receiving her degree, she pursued a career in the financial industry as a financial advisor for Morgan Stanley. There she was responsible for managing client investment accounts and developing new client relationships. She worked at Morgan Stanley for over three years gaining valuable experience, and then accepted a position in Winnfield, Louisiana for Central Industrial Supply, Inc. There she was responsible for financial and accounting activities of the business. In 2003, Rebecca returned to Louisiana State University to pursue her Master of Science degree in Agricultural Economics. She is currently employed as Manager by Central Industrial Supply, Inc.